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Кафедра иностранных языков

АНГЛИЙСКИЙ ЯЗЫК

**Учебно-методическое пособие
для студентов специальности
1-57 01 01 «Охрана окружающей среды
и рациональное использование природных ресурсов»**

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Учебно-методическое пособие по английскому языку представляет собой комплекс текстов по химической тематике из оригинальных англоязычных источников и имеет своей целью развитие и совершенствование у студентов навыков различных видов чтения с выходом в устную речь в пределах предложенной тематики.

Пособие предназначено для студентов II курса специальности 1-57 01 01 «Охрана окружающей среды и рациональное использование природных ресурсов», а также магистрантов и аспирантов. Оно может использоваться и для обучения студентов III и IV курсов на факультете общественных профессий.

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ПРЕДИСЛОВИЕ

Настоящее учебно-методическое пособие предназначено для студентов II курса специальности «Охрана окружающей среды и рациональное использование природных ресурсов», а также магистрантов и аспирантов. Оно может использоваться и для обучения студентов III и IV курсов по профессии «референт-переводчик научно-технической литературы» на факультете общественных профессий.

Учебно-методическое пособие составлено в соответствии с требованиями программы по иностранным языкам для неязыковых вузов. Его целью является совершенствование навыков чтения, понимания и перевода оригинальных текстов по специальности, а также развитие навыков устной речи в пределах предложенной тематики.

Текстовой материал пособия освещает проблемы радиации, промышленного загрязнения, загрязнения окружающей среды и их последствий для человека и планеты. Пособие состоит из основных текстов, сопровождающихся активным словарем и системой лексико-грамматических упражнений, и дополнительных текстов, содержащих новую информацию и связанных с тематикой основных текстов. Дополнительные тексты могут быть использованы при ведении бесед и для составления различных сообщений. При отборе текстов учитывались такие принципы, как информативность, предметная связность, доступность, соблюдение которых способствует расширению профессионального кругозора и усвоению определенного объема профессиональных терминов.

Материалом для данного пособия послужили тексты, подобранные из аутентичных британских и американских научных журналов, содержащие профессионально значимую и познавательную информацию.

Использование пособия в учебном процессе позволит ускорить формирование у студентов навыков и умений, необходимых для чтения и реферирования научных текстов, а также будет способствовать повышению качества перевода литературы по специальности.

Данное издание может быть использовано как для аудиторных занятий под руководством преподавателя, так и для самостоятельной работы студентов.

UNIT I

RADIATION, ITS ORIGIN AND CHARACTERISTICS

Exercise 1. Read and memorize the following words:

Origin − происхождение, источник; ionise − ионизировать; vital − жизненный, жизненно необходимый; sunburn − загар; deal with − иметь дело с, рассматривать; refer to − ссылаться на, говорить о; average − средний, обычный; exposure − экспозиция, время воздействия, (радиационное) облучение; thorium − торий; occur − происходить, случаться, встречаться (в природе); emit − испускать, выделять, излучать; nucleus (pl. – ei) − ядро атома; proton − протон; electron − электрон; neutron − нейтрон; human − человеческий, свойственный человеку; sense − чувство, ощущение; exist − существовать; issue − выпускать, пускать в обращение; monitor − датчик, дозиметр; running − пробеговый; total − сумма, итог; ensure − обеспечивать, гарантировать; permissible − допустимый; thoron − торон; exceed − превышать; sievert − зиверт; replace − заменять, замещать; particle − частица; charge − заряжать, заряд; due to − благодаря, из-за; penetrate − проникать внутрь, проходить; require − требовать; shield – защищать, прикрывать, заслонять; reduce − снижать, уменьшать, сокращать; intensity − мощность, интенсивность, сила.

***Exercise 2. Read the following verbs, mind the pronunciation of the suffix "-ed"*:**

Referred, formed, lived, composed, decided, included, produced, emitted, described, existed, measured, absorbed, issued, exceeded, stopped, exposed, detected.

***Exercise 3. Translate the following words, remember the suffixes forming nouns*:**

Measurement, radiation, existence, composition, emission concentration, detection, exposure, reduction, absorption, reference, inclusion, decision, description, requirement, penetration, replacement, production, difference.

***Exercise 4. Form the comparative and the superlative degrees of the following adjectives*:**

Good, simple, low, thin, heavy, great, stable, radioactive, easy, large, important.

***Exercise 5. Compare the meanings of the verb "to have" in the following sentences. Translate them into Russian*:**

1. Alpha particles have low penetrating power. 2. Man has always lived in a naturally radioactive world. 3. The experiment had to be repeated twice. 4. Our organization has published recommendations for protection against radiation. 5. Having carried out their experiment, they could have a rest. 6. Due to the work of the International Commission on Radiological Protection (ICRP) we have a system of dose limitation. 7. Radioactive discharges into the environment have to be strictly controlled.

Exercise 6. Read and translate the text.

Radiation, its Origin and Characteristics

What is radiation? Man has always lived in a naturally radioactive world. Radiation has been present in the environment since the earth was formed. Some radiation in the environment today is man-made, but for the average member of the public, the greatest exposure comes from natural sources. In nature, there are 100 or so different chemical elements. Examples include light elements − hydrogen, carbon, oxygen − and heavy elements – uranium and thorium. All matter is composed of one or more of these elements. Of the elements which occur in nature only a few emit radiation. The structure of the atom decides the type of radiation which is produced from these radioactive elements.

The number of protons or electrons gives chemical characteristics to an element and the atomic number; for instance, atoms of oxygen have 8 protons and electrons and so the atomic number of oxygen is 8. The atoms, of many elements are stable because they have the right balance of protons and neutrons in the nucleus. Where, however, there is an imbalance of protons and neutrons the atoms are unstable and may change spontaneously into atoms of other elements. When this happens energy is emitted in the form of radiation and the element is described as radioactive. Several radioactive elements exist in nature: uranium, strontium, caesium are the best known. So, radiation is the term used to describe the emission and transmission of energy through space in the form of ways. The phenomenon of radioactivity is the spontaneous breakdown of an atom by emission of particles and / or radiation.

Two energies of radiation are commonly differentiated by the way they interact with normal chemical matter: ionizing radiation (having sufficient energy to ionize the atom) and non-ionizing one (e.g. radio waves, heat or visible light). Both ionizing and non-ionizing radiation can be harmful to

living organisms and can result in changes to the natural environment. In general, however, ionizing radiation is far more harmful to living organisms per unit of energy deposited since the ions that are produced by it, even at low radiation powers, have the potential to cause DNA damage. By contrast, most non-ionizing radiation is harmful to organisms only in proportion to the thermal energy deposited, and is conventionally considered harmless at low powers which do not produce significant temperature rise.

How is radiation detected and measured? Radiation can't be detected by the human senses. However, it can easily be detected and measured by simple instruments. The radiation dose absorbed by the body or parts of the body can also be measured. Personal monitors such as Geiger counters are issued to all people who are likely to be exposed to extra radiation during their work. Running totals of exposure are kept to ensure that permissible levels are not exceeded.

Radiation dose is expressed in sieverts (Sv), or micro-sieverts (micro Sv), which are one millionth of a sievert. These are gradually replacing the older units of the rem or millirem (mrem); (1 sievert – 100 rem).

Are there different types of radiation? Yes. The types of radiation most commonly emitted by radioactive elements are alpha particles, beta particles and gamma rays. Alpha particles are helium nuclei, electrically charged, and are composed of two protons and two neutrons. Due to their large mass and charge they have low penetrating power and can be stopped by a sheet of paper. A beta particle is an electron and has greater penetrating power than the alpha particle but it can still be stopped by a thin sheet of solid material. Gamma rays are similar to X-rays and are a form of high energy electromagnetic radiation. Their penetrating power requires much heavier shielding, such as a thick sheet of steel, to reduce their intensity.

***Exercise 7. Answer the following questions*:**

1. How many types of radiation are there? 2. What are they? 3. Which type is vital to life? 4. What is ionising radiation? 5. What sources of radiation do you know? 6. Which of them are more dangerous today? 7. How many chemical elements are there in nature? 8. Are all of them radioactive? 9. Name some radioactive elements. 10. What does the type of radiation depend upon? 11. What gives chemical characteristics to an element? 12. Why are atoms stable? 13. What happens if there is an imbalance of protons and neutrons in the nucleus? 14. Can radiation be detected by the human senses? 15. How is it detected? 16. How is the radiation dose expressed? 17. What are alpha particles? 18. Why do they have low penetrating power? 19. What can stop them? 20. What particles have greater

penetrating power: alpha or beta? 21. What are gamma rays? 22. Give the definitions of radioactivity and radiation.

***Exercise 8. Find the pairs of antonyms*:**

Harmful, simple, never, man-made, absent, easy, useful, include, different, less, many, new, high, same, thick, increase, exclude, decompose, more, stable, heavy, natural, difficult, old, few, reduce, thin, low, compose, present, always, complex, unstable, light.

***Exercise 9. Find the pairs of synonyms*:**

Common, due to, type, for example, different, several, reduce, deal with, usual, a few, man-made, emit, concern, too, for instance, make up, because of, decrease, change, radiate, some, various, compose, kind, artificial, also, alter.

***Exercise 10. Find the sentences where the word "change" is a noun*:**

1. It is an example of a physical change. 2. The properties of this substance will change. 3. The change from one state into another was accompanied by the emission of gamma rays. 4. Nuclear changes may be expressed by equations. 5. During this reaction the radiation level changes gradually.

***Exercise 11. Translate the following sentences, paying attention to the Subjective Infinitive Constructions*:**

1. Helium is found to have a wide variety of technological uses. 2. The discharge of radioactive gases from that nuclear site proved to be rather low. 3. Uranium is known to be a natural radioactive material. 4. There must be a law concerned with radiological protection as the nuclear power industry is sure to continue its development. 5. In this case temperature is unlikely to affect the radiation level. 6. Nuclear stations are considered to be a major source of electric power. 7. After Chernobyl catastrophe radiation proved to be a killer, which can be neither felt nor seen.

***Exercise 12. Choose the correct word from the list below*:**

1. The smallest particle of any substance. 2. The nucleus of a helium atom emitted from a radioactive substance. 3. The central part of an atom containing protons and neutrons. 4. An electron emitted by an atom in the process of radioactive decay. 5. Natural disintegration of elements such as radium, actinium and uranium, in which alpha and beta particles as well as gamma rays are emitted. 6. A unit in which radiation dose is expressed.

(Nucleus, radioactivity, atom, sievert, beta particle, alpha particle.)

***Exercise 13. Read the additional text and do the tasks and discuss it*:**

The Radiation from Food We Get

Many of the foods we eat contain radioactive atoms, contributing about 29 mrems per year. These radioactive atoms and their nonradioactive counterparts occur naturally. They come from the soils in which the foods are grown. Potassium is a mineral important for health. Potassium-40 (K-40) is a naturally occurring radioisotope of potassium, and, thus, is incorporated into our foods. This table is a listing of the potassium content of some foods, along with the radioactivity of potassium-40 in those foods, measured in disintegrations per second (dps).

Potassium Content and K-40 Activity of selected Foods

Food	Quantity	Potassium, mg	K-40, dps
Hamburger	4 oz	960	29
Chicken, fried	¼ chicken	240	7
Hot dog	2 regular	200	6
Corn	1 ear	200	6
Banana	1 small	370	9
Apple	1 medium	160	7
Milk whole	1 cup	370	11
White bread	1 slice	30	0,9
Egg	1 large	65	2
Porridge	1 plate	130	4
Butter	1 tablespoon	100	3
Corn flakes	1 oz	14	0,4
Cola beverage	12 oz	13	0,4

Note: oz = ounce = 28,35 gr., mg = milligram, dps = disintegration per second.

Tasks: a) list the food you have eaten this week that contain potassium;

b) calculate the total number of dps of K-40 from the food you have eaten;

c) calculate the number of dps due to K-40 in your body;

Note: there are about 60 dps in your body due to K-40 per kilogram of body mass 960 dps/kg body mass;

d) compare the data obtained in tasks d and c. How can you account for any difference? Could you reduce your annual internal exposure to radiation? Do we need any change in our diet?

***Exercise 14. Translate the following sentences into English*:**

1. Радиация – (излучение) поток частиц – фонотонов (света), электронов, нейтронов, альфа-частиц и других, взаимодействие которых с веществом приводит к ионизации и возбуждению его атомов и молекул.
2. Радиоактивность – распад ядер атомов некоторых элементов с одновременным излучением альфа, бета, гамма частиц.
3. Существует два вида радиации: естественная и искусственная. Естественную радиацию открыл Г. Беккерель, а искусственную – Кюри.
4. В природе существуют легкие и тяжелые элементы, и только некоторые из них излучают радиацию, например: радий, стронций, цезий.
5. Радий – радиоактивный химический элемент, атомный номер 88, серебристо-белый металл, химически активен.
6. Радий растворяется в воде, окисляется в воздухе, встречается в урановых рудах. Его используют в виде хлорида и бромида как источник радиоактивного излучения при лечении опухолей.
7. Радиацию нельзя обнаружить и измерить человеческими ощущениями, поскольку она не имеет ни цвета, ни запаха. Ее измеряют специально разработанными приборами, счетчик Гейгера – один из них.

***Exercise 15. Complete the following sentences*:**

1. Radioactivity is … .
2. Radiation is … .
3. There are two types of … .
4. Some radiation in the environment today is … .
5. Radiation can’t be detected by human … .
6. Radiation dose is expressed … .
7. Penetrating power of alpha, beta particles and gamma rays can be stopped by … .

UNIT II

NATURAL AND MAN-MADE RADIATION

***Exercise 1. Read and memorize the following words*:**

Distribute – распределять, распространять; surroundings − окрестности, окружение, среда; terrestrial − земной; internal − внутренний; external − внешний, наружный; radon − радон; dwelling − жилище, дом; restrict − ограничивать; outer space − космос; background − фон; double – двойной, усиленный; adverse − неблагоприятный, вредный; health – здоровье; probably − вероятно; chest − грудная клетка; nuclear weapons – ядерное оружие; luminous − светящийся; travel − путешествие, движение; altitude − высота; estimate − оценивать, подсчитывать; annual − ежегодный, годовой; considerable − значительный, важный; occupational − профессиональный; further − добавочный, дальнейший; miner − шахтер, горняк.

***Exercise 2. Read the following words, mind the pronunciation of the ending "-s (-es)"*:**

a) sources, substances, purposes, mines, watches, altitudes, doses, changes, times, particles;

b) penetrates, gives, releases, receives, includes, uses, compares, continues, operates, raises, damages.

***Exercise 3. Form adjectives with the opposite meaning according to the model in (im, ir, il), un + a – a, e.g. "pure – impure" and translate the words obtained*:**

In − active, accurate, attentive, comparable, correct, dependent, direct, effective, human, soluble, significant, visible, organic, sufficient;

Im − possible, material, mobile, modest, moral, perfect, possible;

Ir − rational, regular, resistant;

Un − safe, equal, known, favourable, pleasant, true.

***Exercise 4. Translate the following sentences, paying attention to the meaning of the verb "to be"*:**

1. The Conference on Radiological Protection is to take place in our institute. 2. X-rays were discovered in 1895, radioactivity was discovered in 1896, the new radioactive elements polonium and radium were isolated in the same year. 3. Helium is in various naturally occurring minerals. 4. At present this Commission is working put standards of radiation protection.

6. The Central Electricity Generating Board (CEGB) operates its power stations to ensure that radiation doses to the staff are minimum and that the limits are not exceeded. 7. Use of new atomic power sources of tremendous energies is of great significance for the national economy.

***Exercise 5. Read and translate the text*:**

Natural and Man Made Radiation

What are the natural sources of radiation? Naturally occurring radioactive materials are distributed across the whole of the earth in soils, rocks, water and plants. The radiation emitted from the surroundings is called terrestrial radiation. Naturally radioactive materials are present in our own bodies and the radiation emitted from these materials is known as internal radiation.

Uranium is a radioactive material dispersed throughout soil and rock. As it decays the radioactive gases radon and thoron are produced which normally disperse into the atmosphere. The concentrations are low but detectable. When radon and thoron enter a dwelling from the walls or floor, higher concentrations may build up if ventilation is restricted.

Radiation, from outer space and from the sun, known as cosmic radiation, is largely absorbed by the atmosphere but some penetrates to ground level where it adds to the natural background radiation.

The total radiation dose per person in the UK in a year from all natural sources, such as cosmic, terrestrial and from within the body, is an average 1870 micro Sv (187 mrem). In some areas of the UK the natural background dose due to terrestrial radiation may be double the average and in some parts of the world it is many times higher. Scientists estimate that the average person in the USA receives a dose of about 360 mrem of radiation per year. 80% of 5that exposure comes from natural sources: radon gas, the human body, outer space, rocks and soil. The remaining 20% comes from man-made radiation sources, primarily medical X-rays.

What about man-made radiation? The X-ray equipment used in hospitals is probably the best known source. A chest X-ray gives an effective dose of about 20 micro Sv (2 mrem). Radioactive substances are widely used for medical purposes.

Artificial radioactive materials have spread throughout the world as a result of nuclear weapons tests in the atmosphere, 20 to 30 years ago.

Other small sources of man-made radiation are: luminous watches; the burning of coal which releases naturally occurring radioactive materials into the environment; and air travel, since at high altitudes there is less shielding from cosmic radiation.

Due to the use of man-made sources of radiation in industry, universities and hospitals, a considerable number of people are exposed to additional small amounts of radiation as a result of their work. This occupational exposure adds an average of 8 micro Sv per person (0.8 mrem), a further 0.4 per cent of the total, and also includes a significant contribution from exposure of miners to radon and thoron and their decay products.

***Exercise 6. Answer the following questions*:**

1. What are the natural sources of radiation? 2. Where can natural radioactive materials be found? 3. What does the term "terrestrial radiation" mean? 4. When are radon and thoron formed? 5. Are they gases or solids? 6. Why are their concentrations rather high in some dwellings? 7. Why does cosmic radiation reach the ground level? 8. What is the average radiation dose per person in the UK? 9. Why is it higher in some areas of the country? 10. What is artificial radiation caused by? 11. What may cause additional radiation?

***Exercise 7. Find the pairs of antonyms and remember them*:**

Artificial, harmful, often, long-lived, dependent, slow, natural, independent, outside, discovered, inside, short-lived, undiscovered, rapid, harmless, light, seldom, heavy.

***Exercise 8. Translate the following parts of the sentences*:**

A. 1. Speaking to the scientists we … . 2. When working at the power station the workers … . 3. The researcher carrying out this experiment … . 4. Reading the document he … . 5. Visiting the atomic station … .

B 1. When heated sufficiently, … . 2. If cooled to 20° C, … . 3. The question involved, … . 4. When removed, … . 5. Produced at the plant … . 6. When produced at the plant, … . 7. If asked about this work, … .

***Exercise 9. Translate the following sentences. Pay attention to the function of the Participles*:**

1. The phenomenon discovered by him helped us greatly in our research work. 2. Isotopes are atoms having the same atomic number but differing in atomic weight (mass number). 3. In the decades following this discovery many scientists in different countries have systematically investigated the nature and the application of radioactivity and of the radiation emitted by radioactive nuclide. 4. The phenomenon is based on the principle that substances occurring in nature, such as uranium and radium, are transformed (into other chemical elements, emitting different kinds of radiation which blacken a photographic plate. 5. One can use several modern

devices while detecting and measuring radioactivity. 6. The field of application of stable isotopes being very wide, the scientists are interested in them. 7. The plastic parts of this device are very difficult to repair if broken. 8. The isolation of radium followed by many important investigations resulted in new discoveries. 9. To obtain compounds rich in stable isotopes a number of physical-chemical methods are used, electrolysis being one of the most important.

Exercise 10. Read the following text. Entitle it.

How does radiation affect people? Alpha particles from ordinary alpha decay do not penetrate skin and cause no damage to tissues below. Some very high energy alpha particles compose about 10% of cosmic rays, and they are capable of penetrating the body and even thin metal plates. However, they are of danger only to astronauts, since they are deflected by the Earth magnetic field and then stopped by its atmosphere. Alpha radiation is dangerous when alpha-emitting radioisotopes are ingested (breathed or swallowed). This brings the radioisotopes close enough to tissue for the alpha radiation to damage cells. Per unit of energy alpha particles are at least 20 times more effective at cell-damage as gamma rays and X-rays. Examples of highly poisonous alpha emitters are radium, radon and polonium. So, radiation can destroy, damage or disturb the function of the living cells in body tissue. The effect depends on the type of radiation, its intensity, the period of exposure and the organs of the body which are irradiated. It has many practical uses in medicine, research, construction, and other areas, but presents a health hazard if used improperly. Exposure to radiation causes damage to living tissue, resulting in skin burns, radiation sickness and death at high doses and cancer, tumors and genetic damage at low doses.

However, there is no evidence that any injury has been caused by radiation to any member of the public or worker employed in the nuclei power stations operated by the Central Electricity Generating Board (CEGB) in some 25 years of commercial reactor operation. The average radiation dose received by any member of the public due to nuclear power is only about a tenth of one per cent of that from natural radiation. Nevertheless, it is important to continue to monitor and control the exposure of populations during the continuing development of the nuclear power industry.

***Exercise 11. Read the additional text on radiation answer the questions and discuss it with your group mates*:**

1. What element is called radon?
2. Where is it produced?

3. How can it get in houses?
4. When does the real threat of radon gas occur?
5. How can it damage our health?
6. How can we protect our homes from radon?

Radon in Houses

The gaseous element radon (Rn) − the heaviest of the noble gases – has always appeared as a component of the Earth's atmosphere. It's a decay product of uranium.

Radon is produced as uranium-238 decays in the soil and in building materials. Some radon produced in the soil dissolves in groundwater. Many houses have foundation and basement floor cracks that permit radon from rooks, soil, and water to seep in. In a tightly sealed house, the radon gas does not have much chance to escape, and radon is now a problem in some areas because of changes in the way we build and use houses. In older houses, outdoor air enters through doors, windows, and the gaps around them, thus diluting radon or removing it from the house. But air conditioning in new buildings decreases the need to open windows. To conserve the energy, many new houses are built more airtight than older houses were. The net result is that indoor air has little chance to mix freely with outdoor air and radon levels may reach high levels. Remedies for high radon levels in homes include increased ventilation, sealing cracks in floors, and removing radon from groundwater. Relatively inexpensive radon test kits are available for home use.

The real threat of radon gas occurs after it is inhaled. Radon decays to produce, in succession, radioactive isotopes of polonium (Po), bismuth (Bi), and lead (Pb). Thus, if radon gas is inhaled, it enters the body and, through radioactive decay, is transformed to these toxic heavy-metal ions that cannot be exhaled as gas. These radioactive heavy-metal ions also emit potentially damaging alpha particles within the body. In houses with abnormally high radon gas level, inhaled dust can also carry traces of the same heavy-metal isotopes deposited by decaying radon. Estimates indicate that about 6% of houses in the United States have radon levels higher than the exposure level recommended by the EPA. It is estimated that around 10% of deaths from lung cancer annually in the United States are due to the effects of radon gas. These figures, although sobering, should be kept in perspective, however. For example, more than 10 times as many people die each year from lung cancer attributed to cigarette smoking.

***Exercise 12. Translate the following sentences into English*:**

1. Существует несколько видов естественной радиации: земная, внутренняя и космическая. Вид радиации зависит от местонахождения радиоактивного материала, излучающего радиацию.

2. Космическая радиация – поток ионизирующих частиц, доходящих до Земли из космического пространства.

3. Радиация, излучаемая из окружающей среды (почва, порода, вода, растения) называется земной радиацией.

4. Внутренняя радиация – излучения, испускаемые радиоактивными веществами, присутствующими в нашем организме.

5. Счетчик Гейгера − детектор ионизирующих частиц, применяется в радиологической защите, создан в 1908 г. Х. Гейгером, усовершенствован в 1925 г. В. Мюллером.

6. Радон – радиоактивный химический элемент, атомный номер 86, газ без цвета и запаха, очень опасен при скоплении в плохо вентилируемом помещении.

***Exercise 13. Compete the following sentences*:**

1. There are such natural sources of radiation as … .
2. Terrestrial radiation is the radiation … .
3. Internal radiation is the radiation … .
4. Uranium is … .
5. Cosmic radiation is … .
6. The total radiation dose per person in different countries is … .
7. Man-made radiation is … .
8. The occupational exposure is … .

Exercise 14. Discuss the origin of radiation, its sources, types and effect.

UNIT III

THE CHERNOBYL AND THE FUKUSHIMA NUCLEAR DISASTERS

***Exercise 1. Read and memorize the following words*:**

Pose – ставить (вопрос, проблему); crossroad – перекресток; approach – подход; soundness − открытость, гласность; hit (hit, hit) – ударять; entire – целый; inflict − наносить ущерб; compatible – совместимый; secure − гарантировать, обеспечивать; necessitate − делать необходимым; resettle – переселять; favour − относиться благосклонно; deteriorate – ухудшаться; underlie − лежать в основе; fail – провалить; doubt − сомневаться, не доверять; worsen – ухудшать; undertake – предпринимать; disease – болезнь; attributable − характерный признак; first and foremost − прежде всего; negligible – незначительный; malfunction − плохо функционировать; thyroid gland − щитовидная железа; immune – иммунный; endocrine – эндокринный; cardiovascular − сердечно-сосудистый; cancer – рак; treat – лечить; retard − задерживать, отставать.

***Exercise 2. Read and translate the following word combinations*:**

A number of the most complicated problems; a kind of testing one's moral principles; in spite of undertaken measures; to necessitate resettlement; to secure safe living conditions, public opinion survey; among the reasons; along with something; to secure employment.

***Exercise 3. Remember the suffixes forming verbs*:**

Worse – worsen	strength – strengthen
Intense – intensify	class – classify
Real – realize	vapor – vaporize

***Exercise 4. Translate the following words of the same root*:**

1. To radiate, radiation, radioactive, radioactivity. 2. To pollute, pollution, pollutant, polluted. 3. To produce, production, product, productivity, produced. 4. To depend, dependence, independent, dependently, dependent. 5. To use, use, useful, useless, usefulness, used. 6. To increase, increase, increasingly, increased. 7. To measure, measurement, measurable. 8. To add, addition, additional, added. 9. To present, to be present, presence, present.

***Exercise 5. Remember the following nouns in singular and plural forms*:**

singular	**plural**
datum	data
phenomenon	phenomena
spectrum	spectra
nucleus	nuclei
radius	radii
analysis	analyses
crisis	crises

***Exercise 6. Remember the meanings of the adverbs formed from the adjectives*:**

near − близкий, около	nearly − почти
main, chief − основной	mainly, chiefly − главным образом
large − обширный	largely − главным образом
high − высокий	highly − весьма, очень
hard − твердый, упорный	hardly − едва
ready − готовый	readily − легко, охотно
necessary − необходимый	necessarily − обязательно

***Exercise 7. Translate the following sentences into Russian*:**

1. Nearly all our students take part in research work. 2. The main problem of our time is the environmental protection, chiefly the problem of clean city air. 3. There is hardly anybody who doesn't know about the threat of nuclear war. 4. Oxygen combines with hydrogen readily. 5. The changes can't be explained by oxidation as such chemical action would hardly be reversible. 6. You should necessarily gain as much as possible in terms of effectiveness. 7. Nearly all the data needed have been received by using the X-ray method.

***Exercise 8. Read and translate the following text*:**

On April 26, 1986 the biggest man-made catastrophe in the history of mankind occurred at the nuclear power plant near the small Ukrainian town of Chernobyl. The Chernobyl disaster posed a number of most complicated economic, ecological, medical, social, demographic and other problems for the state, politicians, scientists and specialists. Chernobyl has become the crossroad of different views, approaches and expertise, a kind of testing the state's moral principles and policy for soundness.

The disaster at the Chernobyl nuclear power plant (NPP) caused radioactive contamination of one fifth of the Belarusian territory with a population of

more than two million people. For 10 days the lethal fire emitted particles 90 times more deadly than those released from the 1945 Hiroshima bomb. The radioactive contamination hit entire ecological systems, farmlands, cities and towns.

Hundreds of thousands acres of arable land were excluded from cultivation. In spite of undertaken measures there were certain problems in obtaining products compatible with the existing standards for radionuclide content in foodstuffs.

The complexity of securing safe living conditions – and in some places its impossibility – necessitated resettlement of people. An independent outflow of part of people (that also took place) caused a number of negative demographic changes.

Public opinion survey showed that the overwhelming majority of the population living in the contaminated zone over 15 curie/km^2 radiation with long-lived isotopes of caesium-137, strontium, plutonium, favoured resettlement. Among the reasons underlying this decision were deteriorating health and doubts about the ability to solve these problems. Along with this, there were unsolved problems in the new resettlement areas. Failure to create adequate infra-structures to secure employment of evacuees and to cater for their everyday needs was among them. The resettlement caused loss in cultural and historical values, removal from the native land. Currently, a great part of the population still resides in the areas of increased radiation. Very often agricultural products from private plots of land are used for food in these areas. So, there is a constant problem of recontamination through the food and water chain. There were passed laws defining legal and socioeconomic status of the radiation contaminated areas as well as the living conditions of the population in them. In spite of the undertaken measures and activities such as evacuation, resettlement, medical treatment, development of uncontaminated food sources and food distribution channels, international extensive logistic and humanitarian assistance over 1,3 million people were registered with Chernobyl linked health problems, e.g. nose bleedings, vomiting, severe headaches, depression, respiratory problems and others. There are indications that even negligible doses of radiation can result in malfunctioning of vital systems of the organisms such as immune, endocrine, cardiovascular ones. The increase of childhood cancer, leukemia and thyroid gland cancer, genetic defects in the children of exposed parents or mental retardation has been reported by the Scientific Research Institute of Radiological Medicine. Fortunately, the childhood thyroid cancer, if detected early, can be treated successfully in the vast majority of cases.

The consequences of the catastrophe were so enormous that it was impossible for Belarus to liquidate them alone. The international community helped Belarusian people with medicine, contemporary medical equipment, funds for realization of protective anti-radiation measures. International cooperation with the goal of studying and minimizing the effects of radiation serves the interests of the entire mankind.

Chernobyl nuclear disaster is the worst nuclear disaster in the history of mankind which had positive effect on the public opinion about the potential danger of nuclear energy. It showed just how expensive mistakes when working with nuclear reactor could be, and forced governments using nuclear energy to search new, much safer types of nuclear reactors, to train highly qualified specialists, to increase nuclear power plant's safety measures to its possible maximum.

***Exercise 9. Answer the following questions*:**

1. What happened in Chernobyl in April of 1986? 2. What questions did it pose for the government and specialists? 3. What territory and people suffered from this disaster? 4. What necessitated the resettlement of people? 5. Why did people favour their evacuation and resettlement? 6. What problems appeared along with the resettlement? 7. Why is there a constant problem of recontamination through food and water chain? 8. What measures and actions did our government undertake to help people exposed to radiation? 9. Who else helped our people and children to recover? 10. How did Chernobyl catastrophe affect people?

***Exercise 10. Find predicates among the marked words*:**

1. We *passed* the gases through the mixer and then *measured* the pressure. 2. This apparatus *tested* in our laboratory *features* extraordinary stability. 3. Further *work* on this problem *led* to *unexpected results*. 4. *The gases heated* before the experiment *enter* the chamber and *condense*. 5. According to the data *borrowed* from various *sources* a slight *change* in the colour *occurred*. 6. Our way of living is going to change, *provided* the scientists *begin* using some new *sources* of energy *located* in the sun. 7. High pressure *forces steam* into *pipes* which *carry* the steam to the condenser. 8. These *stills evaporate distilled* water from salty water. 9. Two volumes of oxygen *mixed* with one volume of sulphur *produce* sulphur dioxide. 10. Carbon *combined* with oxygen *formed* carbon dioxide. 11. The density, the concentration of *dissolved* gases and the temperature *studied established* the optimum conditions for this process.

***Exercise 11. Read and translate the following text using a dictionary*:**

Radiation Effects from Fukushima Daiichi Nuclear Disaster

The Fukushima Daiichi nuclear disaster was a series of equipment failures, nuclear meltdowns, and releases of radioactive materials at the Fukushima I Nuclear Power Plant, following the Tohoku earthquake and tsunami on 11 March 2011. It is the largest nuclear disaster since the Chernobyl disaster of 1986, and only the second disaster (along with Chernobyl) to measure Level 7 on the International Nuclear Event Scale.

Radioactive material has been released from the Fukushima containment vessels as the result of deliberate venting to reduce gaseous pressure, deliberate discharge of coolant water into the sea, and accidental or uncontrolled events. Concerns about the possibility of a large scale release of radioactivity resulted in 20 km exclusion zone being set up around the power plant and people within the 20–30 km zone being advised to stay indoors. Later, the UK, France and some other countries told their nationals to consider leaving Tokyo, in response to fears of spreading radioactive contamination. The Fukushima accident has led to trace amounts of radiation, including iodine-131, caesium-134 and caesium-137, being observed around the world (New York State, Alaska, Hawaii, Oregon, California, Montreal, and Austria). Large amounts of radioactive isotopes have also been released into the Pacific Ocean.

A monitoring system designed to detect nuclear explosions, operated by the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), tracked the dispersion of radioactivity from the crippled nuclear reactor on a global scale. Radioactive isotopes originating from Fukushima were picked up by over 40 CTBTO radionuclide monitoring stations. The CTBTO makes its monitoring data and analysis results available to all its 183 Member States. On 12 March, radioactive releases first reached a CTBTO monitoring station in Takasaki, Japan, around 200 km away from the troubled power plant. By day 15, traces of radioactivity were detectable all across the northern hemisphere. Within one month, radioactive particles were also picked up by CTBTO stations in the southern hemisphere, located for example in Australia, Fiji, Malaysia and Papua New Guinea.

A March 2012 report by the Ministry of Education, Culture, Sports, Science and Technology agreed that radioactive debris from the damaged reactors had dispersed about one-eighth to one-tenth of the distance as those in the Chernobyl disaster. But according to a study conducted by

Norwegian Institute for Air Research, the release of caesium-137 was about 40 percent of the total from Chernobyl.

In March 2011, Japanese officials announced that "radioactive iodine-131 exceeding safety limits for infants had been detected at 18 water-purification plants in Tokyo and five other prefectures". As of July 2011, the Japanese government has been unable to control the spread of radioactive material into the nation's food. Radioactive material has been detected in a range of products, including spinach, tea leaves, milk, fish and beef, up to 200 miles from the nuclear plant. Inside the 12-mile evacuation zone around the plant, all farming has been abandoned.

As of August 2011, the crippled Fukushima nuclear plant is still leaking low levels of radiation and areas surrounding it could remain uninhabitable for decades due to high radiation. It could take "more than 20 years before residents could safely return to areas with current radiation readings of 200 millisieverts per year and a decade for areas at 100 millisieverts per year".

The Fukushima coast has one of the world's strongest currents and this transported the contaminated waters far into the Pacific Ocean, causing a high dispersion of the radioactive elements. Significant pollution of sea water along the coast near the nuclear plant might persist, because of the continuing arrival of radioactive material transported towards the sea by surface water running over contaminated soil. Recent measurements show persistent contamination of some marine species (mostly fish) caught along the coast of Fukushima district. Organisms that filter water and fish at the top of the food chain are, over time, the most sensitive to caesium pollution. It is thus justified to maintain surveillance of marine life that is fished in the coastal waters off Fukushima.

In October 2012 an article in Science-magazine concluded, that at that time radiation was still leaking from the reactor-site into the ocean. Fishing in the waters around the site was still prohibited, and the levels of radioactive Cz and Cr in the fish caught were not lower compared with the levels found after the disaster.

The Japanese government estimates the total amount of radioactivity released into the atmosphere is approximately one-tenth as much as was released during the Chernobyl disaster. Significant amounts of radioactive material have also been released into ground and ocean waters. Measurements taken by the Japanese government 30–50 km from the plant showed caesium-137 levels high enough to cause concern, leading the government to ban the sale of food grown in the area. Tokyo officials temporarily recommended that tap water should not be used to prepare food for infants. A few of the plant's workers were severely injured or killed by the disaster

conditions (drowning, falling equipment damage etc.) resulting from the earthquake. There were no immediate deaths due to direct radiation exposures, but at least six workers have exceeded lifetime legal limits for radiation and more than 300 have received significant radiation doses. Predicted future cancer deaths due to accumulated radiation exposures in the population living near Fukushima have ranged from none to 100. TEPCO admitted for the first time on October 12, 2012 that it had failed to take stronger measures to prevent disasters for fear of inviting lawsuits or protests against its nuclear plants.

Exercise 12. Compare two tragedies in Chernobyl and Fukushima.

***Exercise 13. Translate the following sentences into English*:**

1. 26 апреля 1986 года на 4 блоке атомной станции произошел взрыв, в результате которого были загрязнены радиоактивными веществами территории 3 государств: Беларуси, России и Украины.
2. Свыше 2 миллионов людей нашей страны пострадали от радиации, сотни тысяч из которых стали переселенцами и не смогли вернуться на свои родные земли.
3. Ликвидаторы − это 600 000 молодых людей, посланных для ликвидации последствий взрыва.
4. В течение 80 дней после взрыва население Беларуси подвергалось загрязнению йодом-131, который концентрируется в молочных продуктах и повреждает щитовидную железу.
5. После ядерной катастрофы наблюдается рост числа таких заболеваний, как рак крови, щитовидки, астма, нарушение функционирования иммунной, эндокринной, сердечнососудистой систем.
6. В лесах ягоды, грибы и другие растения сильно загрязнены и опасны при употреблении в пищу без радиологического контроля.
7. Лесная почва все еще сильно загрязнена, т. к. корни, иголки и листья накопили и сохранили радиацию как фильтр. Когда они падают на землю, радиация накапливается там.
8. В глинистых и песчаных почвах распад цезия очень замедлен. Обменные процессы происходят быстрее в более глубоких слоях торфяных почв.
9. Среди домашних и сельскохозяйственных травоядных животных коровы и козы оказались особо восприимчивыми к накоплению радиации в мясе и молоке.

Exercise 14. Speak on the problem of negative effects of radiation on human health, water, air and soil.

UNIT IV

USES OF RADIATION

***Exercise 1. Remember the following words*:**

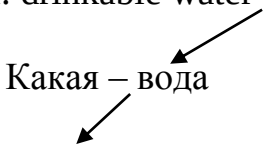
Diagnose − ставить диагноз; cure − лечить; treat − обрабатывать, лечить; treatment − лечение; inject − вводить, впрыскивать; cell − клетка; gene − ген; determine − определять; dislodge − вытеснять; wear − износ; penetrate − проникать; succeed − преуспевать в; dismantle – разбирать (машину).

***Exercise 2. Form adjectives from the given nouns using the suffixes "-less and -ful", translate them and explain the difference in their meaning*:**

Hope, harm, colour, use, taste, help.

***Exercise 3. Define the verbs from which adjectives with the suffix "-able" are formed and translate the given word combinations according to the model*:**

Model: drinkable water – drink − able



Comparable properties, changeable composition, measurable distance, variable amounts, predictable results, the forseeable future, separable components.

Exercise 4. Translate the following sentences paying attention to the meaning of the word "most".

Most	**the most** + прилагательное или наречие	– 1) самый, наиболее; 2) очень, весьма;
	most (of) + существительное	− большинство, большая часть;
	for the most part	– главным образом

1. Solid and liquid substances which are most similar chemically will dissolve most readily in one another. 2. Oxidation of ammonia gives nitric acid which is the basis of most explosives. 3. Hydrogen is now used in large quantities industrially and most of it is obtained from water gas.

4. The best type of design is not necessarily the most complex. 5. Most of the soluble salts are unaffected by boiling.

***Exercise 5. Remember the following expressions*:**

Fresh water − пресная вода; by making a film of radiation – киносъемкой радиации; to require no cutting into the brain − не требовать разрезания мозговой ткани; phosphor crystals − люминесцирующие вещества, светящиеся под действием радиоактивных элементов; weed seeds − семена сорняков; widespread − широко распространенный; accurate diagnosis − точный диагноз; coronary thrombosis − образование свертка крови в одной из артерий сердца.

***Exercise 6. Read and translate the following text*:**

USES OF PADIATION

In medicine radiation and radioactive substances are used for diagnosis, treatment and research. X-rays, for example, pass through muscles and other soft tissue but are stopped by dense materials. This property of X-rays enables doctors to find broken bones and to locate cancers that might be growing in the body. Doctors also find certain diseases by injecting a radioactive substance and monitoring the radiation given off as the substance moves through the body. Radiation used for cancer treatment is called ionizing radiation because it forms ions in the cells of the tissues it passes through as it dislodges electrons from atoms. This can kill cells or change genes so the cells can’t grow. Other forms of radiation such as radio waves, microwaves, and light waves are called non-ionizing. They don’t have as much energy and are not able to ionize cells.

All modern communication systems use forms of electromagnetic radiation. Variations in the intensity of radiation represent changes in the sound, pictures, or other information being transmitted. For example, a human voice can be sent as radio wave or microwave by making the wave vary to correspond variations in the voice.

Today the range of application of radioactive nuclides comprises all branches of research work. Researchers use radioactive atoms to determine the age of different materials, to test metallic and ceramic materials. Isotopes are atoms having the same atomic number but differing in atomic weight. When used by scientists they are very helpful in penetrating into the deepest secrets of some processes. Biologists have succeeded in breeding new varieties of most valuable antibiotics. By means of isotopes it is possible to control the extent of wear of cutting tools or machine parts while in operation without stopping or dismantling them.

***Exercise 7. Answer the following questions*:**

1. What are radiation and radioactive substances used in medicine for?
2. What is the purpose of X-rays application?
3. What kind of radiation is used for cancer treatment?
4. What is the difference of ionizing and non-ionizing radiation in medicine?
5. How can we use radiation in communication systems?
6. How is radiation used in scientific research work?
7. Give the examples of other application of radioactive substances in science?
8. Why is radiation used for cancer treatment, if it is so harmful for health?

***Exercise 8. Find in the text Participles I, II. State their functions and translate them into Russian*.**

***Exercise 9. Read the additional texts on radiation and retell them*:**

Atom Medicine

The use of atom medicine has become so widespread that every big medical centre uses some form of it in diagnosis and treatment. Thousands of hospitals all over the world have had very successful results with radioactive iodine for thyroid cases.

The chief medical use of radioisotopes is against cancer. Every year many thousands cancer patients are being treated with radio-cobalt, which in many ways, is better than X-ray treatment. The radioisotope can be given in smaller doses, and can be concentrated more accurately on the cancerous cells. In addition, it cannot cause burns and has no harmful radiation effect.

Radioisotopes for Diagnosis

In some cases it is important for the surgeon to know whether an injured bone has "died" from loss of blood supply. Many years ago it was necessary to wait several months, and sometimes even a year, for the accurate diagnosis that made treatment possible. Now surgeons have discovered how to find in a few minutes whether the bone has "died". It is done by using a radioisotope-sodium 24. When this isotope pumped into the injured bone, it keeps its radioactivity if the bone is "dead". But, if the bone is still living, the blood carries away the radioisotope within ten minutes. By measuring the amount of radioactivity left in the bone, the surgeon gets the information about the condition of the injured bone.

Diagnosing Heart Ailments

Scientists have discovered that the beginning of coronary thrombosis can be detected and located by the use of radioactive iodine. The isotope of iodine is attracted to inflamed tissues and thus shows the exact place of thrombosis.

Electrocardiograms do not always show the beginning of a heart attack. The use of the radioactive iodine is better than electrocardiogram in this respect: it shows exactly the location of the thrombosis and it is helpful in treatment.

Proton Beams for Brain Operation

In some cases it is necessary to make a brain operation, cutting several nerve tracts. In 1958 surgeons made this operation for the first time with an atomic knife – a proton beam that required, no cutting into the brain.

Usually such operation required weeks of preparation and many weeks of recovery. The atomic operation took about 2 hours; as soon as it was over, the patient walked off to a meal. He didn't feel any pain and only said that he was tired from sitting in the same position for 2 hours.

During the operation the patient was rotated from time to time so that the beam from synchrocyclotron (синхроциклотрон) could strike the brain at different angles. The surgeons directed the beam from another room, giving the patient instructions from time to time by telephone.

The proton beam was 10 mm wide and 2 mm thick. The nerve tract which was cut was 3 mm thick.

Uses of Atomic Energy

Radioisotopes are used in checking different kinds of products. Radioisotopes emit gamma rays of known strength. They are directed through the material which has to be tested. When the strength of the radiation which is coming through the material varies, it is clear that the material has some flaws.

Flaws are also discovered by making a film of the radiation. When engineers see the film, they notice the flaws in the material at once.

Radioisotope examination is also important in bridge construction to check the strength of welding work. Radioisotopes are used for the periodical examination of aero planes to see whether they are safe for flying.

Some railroads are now using atomic warning-lamps. These lamps are covered with phosphor crystals. Krypton-85, a radioactive gas, which is pumped into the lamps, makes the phosphor crystals glow. So the lamp acts as an automatic warning signal. The lamps operate for ten years without replacement.

Radiation and Diamonds

Yellow or brown diamonds are good only for industrial purposes and cost much cheaper than white and blue ones. But with the coming of nuclear age, the color of the diamonds can be changed by radiation from a nuclear reactor.

A nuclear reactor emits neutrons which give diamonds a greenish colour. Beta rays, produced by a cyclotron, colour the diamonds blue. In both cases the colour changes as a result of the impact of the atomic particles on the diamond's structure. The radiated diamonds do not become radioactive and can be worn safely.

Radiation in Biology

Biologists are working hard upon the problem of using radiation to change the properties and qualities of plants. One of the most interesting ideas is to create plants which would grow in the desert and arctic regions. This would greatly increase the world's food supply.

In order to improve the qualities of plants, scientists are using cosmic and atomic rays. The atomic rays are: atomic particles from accelerators; gamma rays from the radioisotope-cobalt-60; neutrons from nuclear reactors.

The radiation of plants will make them more resistant to disease. In the United States alone, the loss from plant disease is more than 3 milliard dollars a year.

Sterilizing the Soil

Sterilizing a hectare of soil by chemical means is very expansive; with the help of the portable nuclear reactor it can be done much cheaper. Besides, the neutrons and gamma rays from the reactor kill all parasites and insects as well as weed seeds.

As the reactor can be operated from afar, the problem of protection of workers from radiation is rather simple.

The radioactivity affects the soil only for a very short time and does not affect the crops at all.

Radiation can also be used to improve the quality of many kinds of products. It may be used to sterilize drugs and cosmetics and to preserve food.

***Exercise 10. Translate the following sentences paying attention to the translation of the marked negatives*:**

1. No other element is more important to life than oxygen. 2. Ice can *never* exist at a temperature above 0°C. 3. Many substances are better solvents for specific organic compounds but *none of* them approaches water as a universal solvent for many different classes of substances. 4. A simple substance can

neither be decomposed *nor* obtained by a chemical combination of other substances. 5. We *don't* consider rain water to be really a pure substance, *nor* is ground water free from impurities. 6. The substance *failed* to oxidize even when exposed to the air. 7. Ammonia is volatile and *unless* the operation is well organized the loss of this expensive reagent is large. 8. Phosphorus doesn't ignite in the air *until* it is heated to a temperature of 240°C.

***Exercise 11. Use the necessary form of verbals and translate the sentences*:**

1. The problem (to concern) is known to be the most difficult one. 2. (to investigate) the properties of this polymer they came to a definite conclusion. 3. The problem of environmental protection (to be) very important, a special committee has been set up under the U.N. organization. 4. The development of modern industry is likely (to accompany) by the development of wasteless production. 5. Primitive man appeared (to disturb) the balance of nature by farming and cattle breeding. 6. The substance begins to melt if (to heat) to a sufficient temperature. 7. The purpose of this computer was to control the operations (to perform) by the new device. 8. The energy (to produce) by the splitting of the nucleus of an atom is (to call) "nuclear" or atomic energy. 9. (to produce) new kinds of materials one should be particular about their quality.

***Exercise 12. Translate the following sentences into English*:**

1. Радиология – наука, а также раздел клинической медицины, использующие ионизирующее излучение и радиоактивные вещества для диагностики и лечения заболеваний.

2. Стронций Sr – химический элемент, атомный номер – 38. Серебристо-белый мягкий металл, химически активен. Энергично разлагает воду, образуя гидроокись, используется в основном в соединениях для производства эмалей, глазурей сигнальных ракет. Получен в 1808 г. Распад 70 лет.

3. Цезий Cz – химический элемент с атомным номером 55. Серебристо-белый мягкий металл, относящийся к щелочным металлам. Химически активен и бурно реагирует с водой и кислородом. Используется в фотоэлектрических элементах. Открыт в 1860 г.

4. Уран U – радиоактивный химический элемент с атомным номером 92. Серебристо-белый тяжелый металл, химически активен. При комнатной температуре устойчив к воздействию воздуха, содержится в минералах и используется как топливо ядерных реакторов и в ядерных бомбах. Растворимые соли урана ядовиты. Открыт в 1789 г.

5. Ионизирующее излучение имеет много практических применений в медицине, научных исследованиях, строительстве и других областях, но представляет опасность здоровью людей, если используется неверно и в больших дозах.

Exercise 13. Speak on the topic "Radiation" using the information about its origin, kinds, negative and positive effects and its application.

UNIT V

INDUSTRIAL POLLUTION

***Exercise 1. Read and memorize the following words*:**

To link – связывать, соединять; to estimate – оценивать, определять; entire – полный, целый, цельный; scope – размах, охват, простор; antiquity – древность, античность; to allow for – принимать во внимание, учитывать; to generate – порождать, вызывать; to compound – соединять, составлять, смешивать; notoriously – особенно, заведомо; consequence – следствие, последствие; sample – образец, проба; trace – след; to degrade – снижать, убавлять, уменьшать; vulnerable – уязвимый, ранимый; awareness – осведомленность; restriction – ограничение; to recognize – признавать, осознавать; obligation – обязательство, обязанность, долг; to highlight – выдвигать на первый план, придавать большое значение; burden – ноша, тяжесть, груз, бремя; to trigger – дать толчок, привести в движение; responsibility – ответственность.

***Exercise 2. Form adverbs adding the suffix "-ly" and translate them*:**

Direct, common, especial, radical, general, rapid, possible, main, hard, natural, close, efficient, definite, previous, temporal, relative, chief, serious, notorious, usual, harmful, wide.

***Exercise 3. Read the text and say*:**

a) what the term industrial pollution means,
b) what effects industrial pollution has.

Industrial Pollution

Industrial pollution is pollution which can be directly linked with industry, in contrast to other pollution sources. This form of pollution is one of the leading causes of pollution worldwide; in the United States, for example, the Environmental Protective Agency estimates that up to 50% of the nation's pollution is caused by industry. Because of its size and scope, industrial pollution is a serious problem for the entire planet, especially in nations which are rapidly industrializing, like China.

This form of pollution dates back to antiquity, but widespread industrial pollution accelerated rapidly in the 1800s, with the start of the Industrial Revolution. The Industrial Revolution mechanized means of production, allowing for a much greater volume of production, and generating a corre-

sponding increase in pollution. The problem was compounded by the use of fuels like coal, which is notoriously unclean, and a poor understanding of the causes and consequences of pollution.

There are a number of forms of industrial pollution. One of the most common is water pollution, caused by dumping of industrial waste into waterways, or improper containment of waste, which causes leakage into groundwater and waterways. Industrial pollution can also impact air quality, and it can enter the soil, causing widespread environmental problems.

Because of the nature of the global environment, industrial pollution is never limited to industrial nations. Samples of ice cores from Antarctica and the Arctic both show high levels of industrial pollutants, illustrating the immense distances which pollutants can travel, and traces of industrial pollutants have been identified in isolated human, animal, and plant populations as well.

Industrial pollution hurts the environment in a range of ways, and it has a negative impact on human lives and health. Pollutants can kill animals and plants, imbalance ecosystems, degrade air quality radically, damage buildings, and generally degrade quality of life. Factory workers in areas with uncontrolled industrial pollution are especially vulnerable.

A growing awareness of factory pollution and its consequences has led to tighter restrictions on pollution all over the world, with nations recognizing that they have an obligation to protect themselves and their neighbors from pollution. However, industrial pollution also highlights a growing issue: the desire of developing nations to achieve first world standards of living and production. As these countries industrialize, they add to the global burden of industrial pollution, triggering serious discussions and arguments about environmental responsibility and a desire to reach a global agreement on pollution issues.

***Exercise 4. Answer the following questions*:**

1. What is industrial pollution? 2. Why is industrial pollution a serious problem for the entire planet? 3. When did widespread industrial pollution accelerate rapidly? 4. How can industrial pollution cause widespread environmental problems? 5. Does it have a negative impact on human lives and health? 6. Who is especially vulnerable in areas with uncontrolled industrial pollution? 7. What issue does industrial pollution highlight?

***Exercise 5. Find the pairs of synonyms*:**

Entire, impact, to generate, to link, influence, duty, for example, to connect, whole, to produce, clean, to speed up, factory, to compose,

production, reason, to compound, obligation, plant, to degrade, to accelerate, pure, for instance, to decrease, manufacture, cause.

***Exercise 6. Read and translate the sentences, paying attention to the meaning of the word "cause"*:**

cause – *n* причина; *v* вызывать, причинять
cause + инфинитив – заставлять

1. Carbon monoxide causes the pollution of air. 2. At high concentration sulphur oxides are the causes of vegetation misbalance. 3. Automobile exhaust gases are the cause of increasing CO concentration in air. 4. Industrial activity is known to cause noticeable effect on a global scale. 5. Water pollution is caused by dumping of industrial waste into waterways. 6. The initiative of "Green Peace" movement caused the world public to pay special attention to the problem of environmental protection.

***Exercise 7. Read and translate the sentences, paying attention to the meaning of the word "matter"*:**

matter *n* − материя, вещество; дело, вопрос
matter *v* − иметь значение
as a matter of fact − в действительности
no matter (how, when, of what etc.) − независимо (от того как, когда, из чего и т. д.)

1. As a **matter** of fact the variation in wave lengths is the principal distinction between different types of electromagnetic radiations. 2. To repeat this experiment was a **matter** of several hours. 3. Synthetic rubbers are a **matter** of considerable discussion at the present time. 4. No **matter** how prepared, the composition of a substance is always definite. 5. The primary consideration controlling the choice of material of construction is the matter of cost. 6. As a **matter** of fact the first discovery of isotopes was made by means of radioactive analysis. 7. Optics is concerned with the application of light energy to the behaviour of **matter**. 8. Chemical reactions, being a **matter** of electrical movement of the atom's electrons, are often easier to measure by amount of heat absorbed or evolved. 9. Electromagnetic wave does not require **matter** in order to move and this is the essential difference between the former and water wave. 10. There is a tendency for **matter** to achieve maximum stability. 11. It does not **matter** whether a substance is found naturally or prepared artificially, its composition is always definite. 12. It is its solubility in many solvents that **matters** very much.

Exercise 8. Read and translate the sentences, paying attention to the meaning of the word "means".

means *n* − способ, средство
mean (meant) *v* − означать
mean *a* − средний, средней величины
by means of *prep* − при помощи
by no means − никоим образом
by all means − во что бы то ни стало

1. The investigations which followed the discovery of the electron, of X-rays, and of radioactivity provided the **means**, both experimental and theoretical, for studying the chemical bond, the structure of molecules and the structure of the solid state. 2. The solubility of a substance **means** the amount of that substance which will dissolve in a specified solvent. 3. The molecular formulas of compounds are determined by chemical **means**. 4. The colour of plastic is rather stable, which **means** that they need to be repainted less frequently than metals and other materials. 5. For our experiment we must find the **means** of several temperature measurements by all **means**. 6. Electromagnetic radiation **means** the production of energy waves because of vibration of electrically charged particles. 7. Oxidation and reduction are by no **means** confined to the change from the atomic state to the ionic state and vice versa. 8. Until the end of the nineteenth century chemists said that elements could not be converted into one another by any known **means**. 9. It is necessary to remember that molecules possess kinetic energy which **means** that they are in constant motion.

Exercise 9. Read and translate the sentences, paying attention to the meaning of the word "involve".

involve *v* − включать в себя; вызывать что-л.; быть связанным с чем-л.

involved (in) − сложный; связанный с, занимающийся; рассматриваемый: данный, имеющийся

involving − с, связанный с…

not involving − без

1. The process of solution **involves** a complete mixing of the molecules of one substance with the molecules of the other. 2. Laboratories **involved** in the study of atoms and their nuclei frequently describe energies in MeV (million electron volts) or BeV (billion electron volts) because one electron volt is quite a small amount of energy. 3. The compounds **involving** radicals are often ionic because of the transfer of electrons. 4. The

chemical equation also tells how much of each substance is **involved**. 5. A constructional material must also have sufficient strength and rigidity at the temperature **involved**. 6. Other known nuclear reactions **involve** a proton, a neutron, an alpha particle or a photon, interacting with the nucleus of an atom. 7. Water takes part in hydrogen reactions **involving** coordination of water molecules with metallic ions and with various elemental and gaseous substances. 8. At higher base concentrations complexes **involving** two molecules are formed. 9. The process of isolating the radium compound from the barium **involved** fractional crystallization. 10. Perhaps the simplest process of the production of electricity **involves** the transformation of chemical energy. 11. The details of the reactions **involved** depend on the place which the metal occupies in the electronic series. 12. The part of the atom that is directly **involved** in the process of chemical change is the electron. 13. The problem to be solved is rather **involved**.

***Exercise 10. Choose the correct tense form*:**

1. Man's interference in nature (increased, has increased) with the development of civilization. 2. Elements (are transformed, transform) into other elements both by man and by nature. 3. Scientists (have found, have been found) ways of measuring the sizes and positions of bodies in the Universe. 4. The Mendeleyev system (has served, served) for almost 150 years as a key to discovering new elements. 5. Electric cars (will be used, will use) in future. 6. Now plastics (are applying, are being applied) for car bodies. 7. Air pollution from industrial accidents (causes, is caused) major health problems. 8. Water pollution from industry can occur, when factories (discharge, are discharged) their effluents directly into rivers, lakes and oceans. 9. By now the pollution and poisoning of the soil, water and air (have reached, are reached) a critical level. 10. The international organization Greenpeace (is doing, is being done) much to preserve the environment. 11. Many industrial cities (suffer, are suffered) from smog. 12. Every year millions of tons of dust and harmful substances (pollute, are polluted) the atmosphere. 13. Water pollutants (result, are resulted) from many human activities.

Exercise 11. Translate the following sentences into Russian, paying attention to the modal verbs.

1. Nowadays, the amount of smoke produced when burning fuels can be reduced. 2. Plastics should be reinforced by different kinds of fibers. 3. One object may be larger than another one, but it may weigh less. 4. These new materials had to withstand much higher temperatures than metals. 5. Ethylene gas may be

obtained by cracking petroleum. 6. The chemists may use the reactor to analyze various substances for their exact composition. 7. Chemical means had to be used for the separation of compounds into their elements. 8. One can use several modern devices while detecting and measuring radioactivity. 9. New types of plastics had to be obtained for space technology. 10. Our idea was to design a new device for automatic control. 11. Pollutants can enter the environment naturally or through human activity. 12. We must all learn to use less energy and we should make power stations and other industrial processes more efficient. 13. As environmental protection is a universal concern, serious measures to create a system of ecological security should be taken.

Exercise 12. Read the text and entitle it.

The volume of both industrial and domestic waste has increased dramatically over the past 50 years. Industrial air pollution includes the greenhouse gases carbon dioxide and chlorofluorocarbons. It also includes sulphur dioxide and nitrogen oxides, which lead to acid rain. The largest single cause of industrial air pollution is the electricity industry. All fossil fuels produce carbon dioxide; coal and crude oil also produce sulphur dioxide and nitrogen oxides. We must learn to use less energy, and make power stations and other industrial processes more efficient. Industries can reduce sulphur dioxide emission by a process called fluidized bed combustion. This eliminates 90 per cent of sulphur dioxide and also reduces nitrogen oxides because the coal burns at lower temperature. But the technology of fluidized bed combustion is expensive, and it would lead to a large increase in the cost of electricity. Air condition from industrial accidents occasionally causes major health problems. The explosion at the chemical plant in India in 1986 killed about 4,000 people and caused nerve damage in thousands more.

***Exercise 13. Read the text and answer the following questions*:**

1. How can water pollution from industry occur? 2. What toxic chemicals does the industrial waste contain? 3. Do they cause health problems?

Water pollution from industry can occur intentionally, when factories discharge their effluents directly into rivers, lakes, and oceans, or unintentionally, when accidents cause leakage of toxic waste into the water supply. Every single day, industrial effluents dump the following waste into the New York estuary: 2,600 metric tons of carbon; 870 tons of oil, grease and other petroleum products; 520 tons of nitrogen-based fertilizers; 230 tons of iron; 0.3 tons of mercury; and 0.014 tons of polychlorinated biphenyls (PCBs). PCBs are byproducts in the production of plastics; they are highly

toxic chemicals which enter human tissues via the food chain. Our bodies cannot excrete PBCs; they will continue to build up inside us throughout our lives. Another very toxic waste product is dioxin, present in bleached paper products such as disposable diapers, toilet paper and coffee filters. The bleach is only necessary because people expect these products to be white; unbleached "environmentally friendly" toilet paper is a dirty gray colour, is much cleaner in long term. Factory effluents also discharge large pieces of solid waste such as disused machinery, plastic sheets and wire netting. This junk is not only ugly, both animals and ships can be entangled in the debris.

Exercise 14. Read and translate the text. Speak about other forms of pollution.

Another pollutant of water is oil. Some of it comes from accidents like the Exxon Valdez tragedy in 1990, some from deliberate washing of tanks at sea and some from industrial effluents. Oil coats the feathers of sea birds and the scales of fish. It also has a less visible toxic effect: it reduces the level of oxygen, dissolved in water. Without dissolved oxygen, the sea cannot support any life at all. As well as the fish and seagulls that we can see, oil kills millions of tiny plants and animals in the deeper layers of the ocean. Acid rain is another important cause of water pollution and the destruction of aquatic life. Yet another cause is thermal pollution. Industries which use water for cooling (such as nuclear power stations) increase the temperature of nearby rivers and lakes by 5–10 degrees. Thermal pollution kills some animals and plants outright. In addition, together with domestic sewage and artificial fertilizers, it promotes overgrowth of bacteria and disrupts the aquatic ecosystem. Industries argue that it would cost too much money to cool the water down before releasing it into the environment.

Exercise 15. Read and translate the text, using the dictionary.

The pollution from coal plants has got to be the worst of the industrial pollution out there. The particles released into the environment from burning coal are a toxic stew that has caused some serious environmental, health, and economic problems across the nation. The Oak Ridge National Laboratory studies the effects of burning coal and some of the results of these studies are no less than shocking. An ORNL report titled "Coal Combustion: Nuclear resource or danger" concluded that since the country has been burning coal, more than 1000 tons of fissionable uranium-235, the same fuel used for nuclear reactors, has been introduced into the environment in the fly ash. If all of the fly ash were to be filtered by properly func-

tioning precipitators then 99% of all fly ash would be filtered and stored in fly ash ponds. This still indicates that roughly ten tons of fissionable uranium has been vaporized into the atmosphere over the United States during the past 75 years. This is only the pollution from the burning of coal in the United States. Imagine what is released in places like China and India where environmental regulations are not nearly as stringent. If we could figure out a way to mine uranium from coal ash then we could theoretically fuel our country's nuclear power plants for another 50 years.

***Exercise 16. Translate the following sentences into English*:**

1. Ежегодно миллионы тонн вредных и токсичных веществ загрязняют атмосферу, воду и почву нашей планеты.

2. Загрязнение окружающей среды увеличивает количество заболеваний, повышает стоимость медицинских услуг.

3. Одной из серьезных проблем для всей планеты является загрязнение окружающей среды промышленными отходами.

4. Нефтяные продукты, попадающие в морские воды, вызывают смерть птиц и морских животных, так как являются очень токсичными.

5. Объем промышленных отходов, выбрасываемых в окружающую среду, растет угрожающими темпами.

6. Кислотные дожди пагубно влияют на растительный и животный мир планеты.

7. Загрязнение промышленными отходами, уничтожающее окружающую среду, заставило всю мировую общественность обратить внимание на принятие серьезных мер по ее защите во имя будущих поколений людей.

***Exercise 17. Complete the following sentences*:**

1. Industrial pollution is … . 2. This form of pollution dates … . 3. The widespread industrial pollution accelerated … . 4. The problem was compounded by … . 5. One of the most common forms of industrial pollution is … . 6. Industrial pollution hurts … . 7. Pollutants can kill … . 8. They imbalance ecosystems, damage buildings, degrade ... . 9. A growing awareness of factory pollution and its consequences has lead to … . 10. Industrial pollution also highlights … .

UNIT VI

SOLUTIONS FOR INDUSTRIAL POLLUTION

***Exercise 1. Read and memorize the following words*:**

Poisonous – ядовитый; damage – повреждать; exposure − подвергание какому-либо воздействию, выставление, оставление (на солнце, под дождем); implement – выполнять, осуществлять; hazardous – опасный, рискованный; solution − метод решения проблемы; distinguish – различать, характеризовать; reduce – уменьшать, сокращать; consumption – затраты, издержки; release – освобождение, избавление; intentional – намеренный, умышленный; prohibit – запрещать; feasible – вероятный, возможный; adversely – неблагоприятно, вредно; pristine – чистый, нетронутый, неиспорченный; pre-emptive – упреждающий; bioavailability – биодоступность; due to – благодаря; dissolute − растворенный; spatially – пространственно; temporally – временно; to contain – ограничивать, сдерживать; retract – вбирать, отводить; build-up – накопление; household – бытовой; incur – навлекать на себя.

Exercise 2. Read and translate the following international words. Use a dictionary if necessary.

Biodiversity; toxification; toxicants; pollutant; anthropogenic; aquatic; biodegradation; intolerant; recolonize; locate; emission; agrochemicals; volatile; pest; pesticide; data; accumulate; extrapolate; correlate; nature; act; economically; cyanide; ammonia; human; pose; degradability.

***Exercise 3. Read and translate the text*: "Solutions for industrial pollution".**

Industrial pollution has adversely affected biodiversity for the last two centuries and continues to increase globally. The effect most closely correlated with loss of ecosystem services is toxification of environment, whereby the organisms living in the ecosystem are damaged because of the poisonous nature of many pollutants. As many toxicants (poisonous materials) can act even with very minimal exposure, it is almost impossible and economically infeasible to remove dissolute pollution from the environment with modern technical methods.

Only spatially and temporally concentrated pollution can be retracted effectively by anthropogenic efforts, and such methods are already in use in such projects as the U.S. Superfund, a program implemented by the Environmental Protection Agency (EPA) to contain hazardous pollution and re-

store polluted sites. Any dissolute pollution (pollution present in low concentrations in aquatic systems) cannot be removed efficiently by human efforts since such large areas are affected and must therefore be removed through natural biodegradation.

The only way to restore biodiversity to areas affected by dissolute pollution is to remove the sources of pollution, make sure that toxic buildups can be naturally removed through chemical, physical and biological processes and ensure that pollution-intolerant organisms have access to recolonize the area. The process, especially of the last two steps, is very time-consuming; it may take 10 to 50 years to increase biodiversity in the system and rebuild ecosystem services, as evidenced from cleanup efforts in the U.K.

To evaluate solutions to pollution, it may be helpful to distinguish between different kinds of industrial pollution. A first and common distinction is between sources of pollution: point sources, which are spatially and temporally defined such as a factory, and non-point sources, which are impossible to locate or confine such as household emissions. Only point sources can be effectively reduced by treatment of waste due to the possibility of regulation, whereas lessening the overall consumption will affect both point and non-point sources. Another distinction may be chosen between the use of the pollutant: agrochemicals, industrial organic and inorganic waste, and household emissions of chemicals.

Organic and inorganic wastes are releases of large amounts of the most ecotoxic materials such as heavy metals, ammonia, cyanide, volatile organic compounds, and halogenated organic compounds. Release of these chemicals into the environment is not intentional; that is, the release of these chemicals is not required in order for any process to work.

Because agrochemicals are intentionally released into the environment, prohibiting their usage would probably not be politically or economically feasible. This kind of regulation would significantly raise food prices and incur food shortages and famines because pests would destroy a significant amount of the crop yield. A feasible solution should include both reduction of use and shifts to less chronically toxic products. As such a solution may lead to a reduction of crop yield and will definitely require farmers in industrialized countries to change their habits; it can only be implemented through enforced government regulations. To make decisions about how to regulate agrochemicals, governments will need objective data on the damage pollutants pose to environments.

Data on ecotoxicity was historically accumulated by reviewing polluted sites and comparing them to pristine sites or to historical data, but this comparison is sometimes difficult due to the absence of truly pristine sites.

Where pollution has already been released into the environment, circumstances previous to the pollution are difficult to extrapolate. Instead, the EPA takes a pre-emptive approach to minimizing damage to ecosystems from pesticides by requiring chemical industries to register new pesticides for use. According to EPA policy, pesticides need to pass a series of tests demonstrating that they are not "unreasonably" harmful to the surrounding ecosystems (concerning both their toxicity and their degradability).

While expansive toxicity databases exist for most laboratory materials, agrochemicals and heavy metal compounds, such data is only just being accumulated for household, medicinal and other regularly applied chemicals and has not yet resulted in governmental regulations even though the amount of use may be considered a valid concern. However, compared to other types of chemical pollutants, most household and medical chemicals do not have comparable ecotoxicity and are less harmful due to environmental concentrations on the parts per trillion scales.

Exercise 4. Answer the following questions.

1. What is the adverse effect of industrial pollution? 2. Why can't many toxicants be removed from the environment? 3. What pollution can be effectively retracted from the environment? 4. What is dissolute pollution? 5. How is biodiversity restored in the areas affected by dissolute pollution? 6. What is recolonization? 7. What kinds of industrial pollution are distinguished? 8. What wastes are the most toxic materials? 9. What is the feasible solution to protect the environment from agrochemical pollution? 10. Why is it hardly possible to find pristine sites? 11. What measures are being taken by EPA according to a pre-emptive approach? 12. What information has been accumulated by toxicity database?

Exercise 5. Find synonyms in the following list of words.

Adversely, database, correlate, remove, distinguish, effect, solution, feasible, method, approach, accumulate, reduction, apply, consider, release, pristine, pollution, contamination, eliminate, influence, information, possible, technique, lessening, take into account, liberation, manner, unspoilt, harmful, build up, compare, discern, use.

Exercise 6. Translate the following sentences. Point out the infinitive constructions. State the function of the infinitive.

1. It is often assumed that governmental restrictions or strong consumer pressure are necessary to cause significant reduction in the production of polluting goods. 2. The EPA reviews research to be submitted before a product can be sold on the market. 3. Industrial pollution has been reported

to increase globally. 4. Poisonous materials can act even with very minimal exposure. 5. Dissolute pollution is almost impossible and economically infeasible to remove from the environment with modern technical methods. 6. To evaluate solutions to pollution, it may be helpful to distinguish between different kinds of industrial pollution. 7. Some effective methods are already in use to contain hazardous pollution and restore polluted sites. 8. The only way to restore biodiversity to areas affected by dissolute pollution is to remove the sources of pollution. 9. EPA takes a pre-emptive approach to minimize damage to ecosystems from pesticides.

Exercise 7. Translate the sentences into English.

1. Многие ядовитые вещества могут воздействовать даже в малых количествах. 2. Существует обширная база данных токсичных веществ, включающая лабораторные материалы, сельскохозяйственные химикаты, соединения тяжелых металлов. 3. Агентство по охране окружающей среды использует метод упреждения, чтобы минимизировать вред, который наносят экосистеме пестициды. 4. Единственный способ восстановить биоразнообразие – это устранить источники загрязнения. 5. Промышленное загрязнение неблагоприятно воздействует на биоразнообразие в течение последних 200 лет. 6. Данное исследование классифицирует биодоступность продуктов для организмов в окружающей среде и их относительную токсичность.

Exercise 8. Read and translate the text "Degrading toxicants", answer the following questions.

1. What methods can help to decrease the availability of chemicals? 2. What are the influential inorganic pollutants? 3. Why is it important to rebuild the ecosystem services?

In the case of pollution leading to buildup of toxic material, reduction of availability to the environment must be ensured to rebuild ecosystem services in a polluted area. Although physical or chemical methods such as change in acidity or absorption into the soil can help decrease the availability of chemicals, additional monitoring and securing is necessary to make sure that the pollutant is not brought back into the environment.

Ideally, the system should be able to degrade the pollutant by microbes or fungi, as this will irreversibly destroy the toxicant. Many inorganic materials take a long time to biodegrade, which means that their buildup rate is almost proportional to the total rate of pollution at any given time. These are also often some of the most potent and generally poisonous materials and thus strongly toxic even in low concentrations. Influential inorganic

pollutants include non-metals like ammonia and cyanide and heavy metals such as Cu, Hg, Cd among others, which are all toxic in various degrees.

Many inorganic discharges are point sources, so proper treatment of material is generally possible through biological degradation with microbes and fungi or electro-kinetic treatment (the use of electricity to reduce heavy metal ions and turn them into elemental precipitates). Also, most heavy metals are much less toxic in alkaline environments, a fact that can be used in treatment plans. Some combination of these three techniques should be established to lower emissions for point source metal pollution.

Exercise 9. Point out which of the words in bold perform the function of the subject of the sentence.

1. Many inorganic **materials** take a long **time** to biodegrade. 2. Some **combination** of these three **techniques** should be established to lower emissions. 3. Influential inorganic **pollutants** include non-metals like **ammonia** and cyanide and heavy metals. 4. It is often assumed that governmental **restrictions** or strong consumer pressure are necessary to cause significant **reduction** in the production of polluting **goods**. 5. Organic and inorganic **wastes** are releases of large amounts of the most ecotoxic **materials**. 6. **Data** on **ecotoxicity** was historically accumulated by reviewing polluted **sites** and comparing them to pristine sites or to historical data. 7. The **effect** most closely correlated with **loss** of ecosystem services is toxification of **environment.** 8. The only **way** to restore **biodiversity** to areas affected by dissolute **pollution** is to remove the sources of pollution.

***Exercise 10. Agree or disagree with the following statements*.**

1. While expansive toxicity databases exist for most laboratory materials, agrochemicals and heavy metal compounds, such data is only just being accumulated for household, medicinal and other regularly applied chemicals.

2. To evaluate solutions to pollution, it is not indispensable to distinguish between different kinds of industrial pollution.

3. Industrial pollution has slightly affected biodiversity for the last two centuries and continues to decrease globally.

4. The EPA takes a pre-emptive approach to minimizing damage to ecosystems from pesticides by requiring chemical industries to register new pesticides for use.

5. Most household and medical chemicals have comparable ecotoxicity and are harmful due to environmental concentrations on the parts per trillion scale.

6. Where pollution has already been released into the environment, circumstances previous to the pollution are difficult to extrapolate.

UNIT VII

REDUCING POLLUTION APPROACHES

***Exercise 1. Read and memorize the following words*:**

Approach – подход; treatment – обработка; fungi (pl) – грибы; threshold – пороговый; facility – средства; оборудование, аппаратура; lack – недостаток, нехватка; restriction – ограничение; prevent – предотвращать; levy – сбор, налогообложение; underestimate − недооценивать; eliminate – устранять, удалять; warrant – подтверждать, гарантировать; incentive – побуждение, стимул; sewage – сточные воды; consumption – потребление; accessible – доступный, достижимый; discharge – выброс, слив, спуск; disposal – избавление, устранение; significant – важный, значительный; shift – сдвигать, смещать; mining – горный, горнодобывающий; awareness – осведомленность; benefit – польза, выгода; non-compliance – неподчинение, несоблюдение.

Exercise 2. Read and translate the following international words. Use a dictionary if necessary.

Priority, degrade, cause, corporation, base, preference, technique, per cent, private, regulation, production, exploit, alternative, result in, counseling, polluter, biomimicry, transition, generate, integrate, urban.

Exercise 3. Read the text "Reducing pollution approaches" and do the tasks following it.

There are two approaches through which pollution can be reduced.

1. Reducing consumption or usage of a polluting product.
2. Treatment of wastes, discharges and disposals of a pollutant.

Yet waste treatment can only be effective if pollution is coming from a defined and accessible source (point source). Many countries, including the E.U., Switzerland, Canada and the U.S., have effectively implemented systems that treat waste water for most chemicals, yet significant improvement in methods are possible. In such improvements, priority should be given to considering the use of microbes or fungi for cleanup of heavy metals and organic compounds that are hard to degrade because of their high efficiency relative to chemical or physical methods.

Most developing and threshold countries lack treatment facilities, meaning waste waters in these countries are significantly more toxic per unit mass then waste water in developed countries, which is also a result of

companies shifting pollution-intensive production to countries with fewer environmental restrictions. This is especially observed in the mining industry, where treatment of waste is often very expensive and pollutants are very toxic.

It is often assumed that governmental restrictions or strong consumer pressure are necessary to cause significant reduction in the production of polluting goods, because there is usually no short-term internal benefit to reducing pollution for corporations. The reasons corporations reduce their pollution are based on consumer preference for low-pollution goods and the high cost of noncompliance with environmental regulations. But reducing pollution does not only mean treating waste or paying for waste removal, which only raises costs. Research suggests that preventing pollution during the production process by reducing use of pollutants or implementing low-use techniques actually increases efficiency and financial performance of private corporations by an additional 5 to 8 percent over five years.

Consumers and governments need to do their part to push companies to decrease pollution. Although pollution prevention can provide a financial incentive for private corporations, consumer pressure is still necessary to develop company awareness of pollution issues. To implement standards throughout a pollution-intensive industry, a government agency must implement environmental regulations. Regulations could include a levy or tax plan which would make polluters pay a fixed amount of money for pollution, a cap-and-trade system which would fix the amount of emissions, prescription of maximum releases, or minimum waste reduction techniques. Such regulations might come with a high cost to production if no comparable alternatives are available and efficiency measures are already exploited.

However, efficiency measures are underestimated by at least 30 percent of managers. The potential for development of efficiency has resulted in a small industry of efficiency counseling, which could be helpful in eliminating unnecessary pollution from industrial processes. In general, government regulations need to be stronger in order to eliminate such industrial overuse of pollutants and provide incentives for research and implementation of more efficient techniques. The exact guidelines must be determined by case, as different pollutants have different effects and can be reduced by different measures, which warrants different approaches.

A long-term solution that could reduce pollution from agricultural chemicals is research into more sustainable methods of farming large amounts of food, such as ecosystem engineering or biomimicry (design and production of materials, structures, and systems that are modeled on biological entities and processes). This research focus is necessary for an

eventual transition to non-polluting agriculture, which is not feasible now because current methods don't work. However, non-polluting agriculture will eventually become necessary, because all pesticides are by definition poisons; indefinitely relying on them is not a solution that will generate integrated ecosystems, which are necessary to eventually increase biodiversity while keeping high yields.

Other organic materials are often not quite as toxic as pesticides, yet studies have found that degraded forms of dichlophenac, a common painkiller, have caused the loss of kites, a carrion-eating bird, in Pakistan and India. Organic solvents can also have high toxicity values, making them ecologically significant as well. Unlike agrochemical pollution, which occupies too much area and includes too many possibilities for runoffs to be modeled as a point source, most other organic chemicals released to the environment are gathered in waste disposals of urban or industrial sewage systems and can theoretically be treated.

For effective treatment, the proper degrading microbes as well as enough time are necessary, which means that extensive treatment plants should be developed for many countries. This treatment could take the form of microbial degradation plants commonly used in industrialized countries or, if sufficient space were available, constructing degrading wetlands could be a cost-effective alternative.

Exercise 4. Answer the following questions.

1. What are two approaches through which pollution can be reduced? 2. What improvements are introduced to make waste treatment system work more efficiently? 3. What difficulties do developing and threshold countries encounter? 4. What is necessary to reduce the production of polluting goods? 5. What is the advantage for producers to reduce use of pollutants? 6. What do governmental regulations include? 7. What is the potential for development of efficiency of environment protection measures? 8. What is biomimicry? 9. How are proper degrading microbes commonly used in industrialized countries?

Exercise 5. Read the text "Recolonization" and make up a written summary what is this text about. Mind the meaning of the following words.

1. Space – пространство; proximity – близость, близкое расположение; pond – пруд, запруда; mammal – млекопитающее; impair – ухудшать, портить; extinction – исчезновение; waterfowl – водоплавающая птица; obstacle – препятствие; be rid of smth – избавляться от чего-либо;

availability – пригодность, полезность; refill – заполнить, восстановить; habitat – среда, место обитания, распространения, ареал животного или растения.

2. Guess the meaning of the international words: toxicity, intolerant, recolonization, reconstruction, isolated, biome, fragmentation, urbanization, era, niche, intervention.

After a site has been rid of its toxicity and offers a space in which normal, pollution-intolerant organisms can live, recolonization and reconstruction of the ecosystem need to occur. This recolonization depends on the availability of organisms to refill the parts of the ecosystem that have been destroyed. If a distinct and isolated environment were destroyed, such as pond ecosystem, not all species may be available in close proximity.

Macroorganisms, like mammals, amphibians, or fish, often have their own mechanisms of travel, yet even many of them need connected biomes (a large naturally occurring community of flora and fauna occupying a major habitat). On the other hand, many smaller organisms that are essential to the ecosystem, such as small insects or microbes, cannot travel on their own and rely on wind, rain, drift, or transportation by other organisms to change places. Macroorganism travel may be significantly impaired by habitat fragmentation through urbanization, pollution of river biomes all the way to their sources, or an extinction or large reduction in numbers of transporting species such as waterfowl.

These obstacles are also often directly correlated to the pollution or the cause of pollution. For instance, strong industrial presence can pollute environments, but will also lead to urbanization and habitat fragmentation due to workers living nearby. If there are no colonies preserved from pre-pollution eras and classical mechanisms of transport have been destroyed for organisms occupying important niches in the ecosystems, careful human intervention may be needed to introduce necessary species.

Exercise 6. Read the text "Action Plan". Pay attention to the facts to be able to answer the following questions. Mind the meaning of the following words.

1. What is the purpose of the action plan? 2. What treatment of waste is necessary if it is inevitable that heavy metals will be released? 3. When should a fixed standard of emissions and ecotoxicity be set? 4. When is a blanket ban introduced? 5. What is bioremediation? 6. What is research necessary to conduct for to reduce industrial pollution?

Tailor – специально приспосабливать для чьих-либо нужд; pose – ставить, налагать; rate – скорость, уровень; inevitable – неизбежный;

precious – ценный; processing – обработка; alkaline – щелочной; precipitate – выпадать в осадок, осаждаться; application – применение; lead – вести куда-либо, приводить; excessively − избыточно, крайне; secure – обеспечивать, страховать; irreversible – необратимый; appropriate − соответствующий.

Any action plan to reduce industrial pollution will need to be tailored toward specific pollutants to work well and not pose undue risks on either the economy or the environment. A slightly generalized plan based on the different kinds of solutions available can be proposed for the different pollutants.

Reduction of Pollution

Toxic metals should have a restriction on maximum environmental release based on relative toxicity levels and accumulation rates in ecosystems. If it is inevitable that heavy metals will be released in waste, treatment is necessary before the waste is to be released into the environment. In a series of steps, electrolysis should be used to reduce precious metals (Cu, Ag), which can then be refined and sold. Then, biological processing with the appropriate microbes should be used to reduce toxicity of very reactive ions (Hg, Cd, Mn). Last, the waste solution should be made slightly alkaline to precipitate as much metal hydroxides as possible before release into the environment.

- Toxic organic compound emissions that are not pesticide applications should be reduced by setting a fixed standard of emissions and ecotoxicity in a cap-and-trade system which can gradually be lowered. Ideally, this would eventually lead to zero emissions, as most organic compounds can be degraded by microbes and thus treated effectively. If compounds are found to be excessively toxic, a blanket ban should be introduced.
- Agrochemicals should be subject to a taxation system in which the ecotoxicity of the compound determines the levy. However, some dangerous pesticides such as atrazine should be incorporated in a cap-and-trade system of dangerous agrochemicals that would gradually be lowered to allow time for transition to less dangerous chemicals. Again, excessively toxic compounds will need to be removed from the market by a blanket ban.

Detoxification and Recolonization

- Strongly polluted sites should be cleaned up through progams such as the U.S. Superfund, though bioremediation and in-site cleanup should be the preferential treatment options.

- Physical and chemical reductions to bioavailability will need to be secured additionally, preferably by an irreversible degradation, so that pollutants cannot be released again.
- Once a site has been detoxified, appropriate measures should be taken to ensure that all important positions of the biome can be fulfilled.

Research is necessary for more advanced treatment plans, systems of production that do not use polluting agents and remediation technology. Research should be influenced by key concepts such as integration of ecosystems and biomimicry.

Exercise 7. Find synonyms in the following list of the words.

Research, treatment, secure, remediation, influence, notion, levy, decrease, abundantly, incorporate, refine, precious, difficulty, impair, deteriorate, excessively, reduction, valuable, investigation, provide, lower, tax, concept, obstacle, processing, affect, introduce, purify.

Exercise 8. Translate the following sentences. Point out the "-ing constructions"; state the function of the verbals.

1. Reducing consumption or usage of a polluting product is one of the approaches to reduce pollution. 2. Waste treatment can only be effective if pollution is coming from a defined and accessible source. 3. Biological processing with the appropriate microbes should be used to reduce toxicity of very reactive ions. 4. If there are no colonies preserved from pre-pollution eras and classical mechanisms of transport have been destroyed for organisms occupying important niches in the ecosystems, careful human intervention may be needed to introduce necessary species. 5. Strong industrial presence can pollute environments, but will also lead to urbanization and habitat fragmentation due to workers living nearby. 6. Macroorganism travel may be significantly impaired by habitat fragmentation through urbanization, pollution of river biomes all the way to their sources, or an extinction or large reduction in numbers of transporting species such as waterfowl. 7. Biome is a large naturally occurring community of flora and fauna occupying a major habitat. 8. If sufficient space were available, constructing degrading wetlands could be a cost-effective alternative. 9. For effective treatment, the proper degrading microbes as well as enough time are necessary, which means that extensive treatment plants should be developed for many countries. 10. Degraded forms of dichlophenac, a common painkiller, have caused the loss of kites, a carrion-eating bird, in Pakistan and India. 11. Organic solvents can also have high toxicity values, making them ecologically significant as well. 12. However, non-polluting agriculture will eventually become necessary, because all pesticides are by

definition poisons; indefinitely relying on them is not a solution that will generate integrated ecosystems, which are necessary to eventually increase biodiversity while keeping high yields.

Exercise 9. Translate the sentences into English.

1. Восстановление колоний зависит от возможностей организмов заполнить те части экосистемы, которые были разрушены. 2. Биом – это крупное, встречающееся в природе сообщество животного и растительного мира в естественной среде. 3. Снижение потребления в целом или потребления загрязняющих товаров – это возможность уменьшить загрязнение окружающей среды. 4. На исследование должны оказывать влияние ключевые понятия, такие как интеграция (объединение) экосистем и биомимикрия. 5. Токсичные металлы должны иметь ограничения на выброс в окружающую среду, в зависимости от уровня их токсичности и скорости накопления в окружающей среде. 6. Эти исследования необходимы для окончательного перехода к сельскому хозяйству, которое не загрязняет окружающую среду. 7. Агрохимикаты должны облагаться налогом, где степень токсичности определяет величину налога. 8. Многие малые организмы, необходимые для экосистемы, не могут перемещаться самостоятельно и зависят от ветра, дождя и т. п.

Exercise 10. Pay attention to different meanings of the word "far" in different word combinations. Translate the following sentences.

far

far *adj* – далекий

far *adv* – далеко

far *adv* − прилагательное в сравнительной степени – гораздо, значительно

by far – безусловно

so (as) far as … is concerned – что касается…

so far as – насколько, поскольку

so far – пока, до тех (сих) пор

far from – далеко от, совсем не

1. At first sight the phenomena of electrolysis are from simple to explain and further experiments are necessary. 2. The small non-metallic atoms exert a powerful attraction on the hydrogen because its electron is so far removed that it is almost a hydrogen ion. 3. Far greater use of plastics is expected in industrial construction. 4. Every enzyme so far isolated has proved to be either a simple or complex protein. 5. The process of fractionation may

be carried so far that a pure crystalline active substance is obtained. 6. Apparatus not immediately required should be kept as far as possible in a neat orderly manner. 7. Coal does far more for each of us than supply the necessary heat to move our trains. 8. So far s we know the oil that we obtain from the earth will not last more than a few centuries at the present rate of consumption. 9. By far the most useful solvents are the hydrides. 10. So far they did not succeed in their efforts to raise the engines.

Exercise 11. Agree or disagree with the following statements.

1. Toxic metals should have a restriction on minimum environmental release based on relative toxicity levels and accumulation rates in ecosystems.
2. Agrochemicals should not be subject to a taxation system in which the ecotoxicity of the compound determines the levy.
3. The waste solution should be made slightly basic to precipitate as much metal hydroxides as possible before release into the environment.
4. Any action plan to reduce industrial pollution will need to be tailored toward specific pollutants to work well and not pose undue risks on either the economy or the environment.
5. Many smaller organisms that are essential to the ecosystem, such as small insects or microbes, can travel on their own and do not rely on wind, rain, drift, or transportation by other organisms to change places.
6. The recolonization depends on the availability of organisms to refill the parts of the ecosystem that have been destroyed.
7. Biomimicry is design and production of materials, structures, and systems that are modeled on biological entities and processes.
8. Biome is a large naturally occurring pattern of flora and fauna occupying a major habitat.
9. Most developing and threshold countries lack treatment facilities.

Exercise 12. Speak on the topic "Pollution in Industry".

UNIT VIII

ENVIRONMENTAL POLLUTION

***Exercise 1. Read and memorize the following pollutants, substances and diseases they cause, that are described in the units below*:**

Pollutants

(*загрязняющие вещества / загрязнители*)

Carbon dioxide emissions – выбросы диоксида углерода; chlorofluorocarbon (CFCs) – хлорфторуглероды; dense non-aqueous phase liquids (DNAPLs) – жидкости плотной неводной фазы; dichloro diphenyl trichloroethane (DDT) / organochlorine insecticide – дихлор-дифенил трихлорэтан / хлорорганический инсектицид; diesel exhaust (DE) – дизельный выхлоп; Environmental Persistent Pharmaceutical Pollutants (EPPP) – экологически стойкие фармацевтические загрязнители; non-methane volatile organic compounds (NMVOCs) – не содержащие метан летучие органические соединения; persistent organic pollutants (POP) – стойкие органические загрязнители; point source pollution (PS) – точечный источник загрязнения; polychlorinated biphenyl (PCB) – полихлорированный бифенил; total suspended solids (TSS) – общее содержание взвешенных твердых частиц; volatile organic compounds (VOCs) – летучие органические соединения.

Substances *(примеси)*

Ammonia (NH_3) – аммиак; carbon dioxide (CO_2) – углекислый газ, углекислота; carbon monoxide (CO) – окись углерода, угарный газ; chlorinated hydrocarbons – хлорсодержащий углеводород; petroleum hydrocarbons – нефтяные углеводороды; methane (CH_4) – метан; naphthalene ($C_{10}H_8$) – нафталин; nitrogen dioxide (NO_2) – двуокись азота; polychlorinated biphenyl – полихлорированный бифенил; polycyclic aromatic hydrocarbons – полициклические ароматические углеводороды; sulfur compounds – сернистые соединения; sulphur dioxide (SO_2) – диоксид серы (сернистый газ); trichloroethylene – трихлорэтилен.

Polynuclear aromatic hydrocarbons

(полициклические ароматические углеводороды)

Anthracene – антрацен; benzo(a)anthracene – бензоантрацен; benzo(a)pyrene – бензопирен; benzo(b)fluoranthene – бензофлуорантен; benzo(k)fluoranthene – бензофлуорантен; indeno(cd)pyrene – инденопирен; phenanthrene – фенантрен.

Microorganisms found in surface waters

(микроорганизмы, найденные в поверхностных водах)

Viruses that cause human diseases *(вирусы, вызывающие заболевания человека)*: Burkholderia pseudomallei – патогенная грамотрицательная подвижная палочковидная бактерия рода Burkholderia; Coliform – кишечная палочка; Cryptosporidium parvum – криптоспоридия парвум; Giardia lamblia – лямблия; Novovirus – нововирус; Parasitic worms (helminths) – паразитические черви (гельминты); Salmonella – сальмонелла.

Diseases *(заболевания)*

Birth defects – врожденный порок, дефект, порок развития; death by exposure via direct contact – смерть от воздействия через прямой контакт; depression of the central nervous system – поражение центральной нервной системы; eye irritation – раздражение глаз; fatigue – усталость, утомление, апатия; headache – головная боль; heart or lung disorders – расстройство работы сердца и легких; inhalation – аспирация; kidney changes – изменения в почках; leukemia – лейкоз, лейкемия, белокровие; liver changes – изменения печени; lung cancer – рак легких; nausea – тошнота; neurologic symptoms – неврологические симптомы; neuromuscular blockage – нервно-мышечная блокада; skin rash – высыпание на коже; to develop cancer – заболевать раком.

Respiratory Diseases

(заболевания дыхательных путей)

Cardiovascular disease (affected by high blood pressure) – сердечно-сосудистое заболевание, протекающее с высоким артериальным давлением; chest pain – боль в груди; congestion (*syn*. flushing, hyperemia) – прилив крови, гиперемия; pulmonary congestion – легочная гиперемия; throat inflammation – воспаление горла.

***Exercise 2. Read and memorize the following words of this unit*:**

Absorptive capacity – поглощающая способность; acidity of ocean waters – кислотность океана; adverse air quality – негативные качества воздуха; biodegradable – разлагаемый микроорганизмами *(о пластмассах)*, портящийся под действием микроорганизмов; chemicals – химикалии, химикаты; contamination – загрязнение, заражение; degradation products (DP) – продукты распада; diluted – разбавленный, разжиженный; discharge of wastewater – сброс сточных вод; domestic sewage – бытовые сточные воды; electrostatic precipitator (ESP) –

электростатический фильтр/осадитель; emission source – источник загрязнения (воздуха); eutrophication – эвтрофикация (зарастание водоема); pollutants – загрязняющие вещества; human amenities – удобства для человека; inappropriate objects – неподходящие объекты; infertile soil – бесплодные почвы; Integrated Pest Management (IPM) techniques – методы комплексной борьбы с сельскохозяйственными вредителями; invasive species – инвазивные (захватнические) виды; littering / roadside litter – замусоривание / мусор на обочинах дороги; marine ecosystem – морская экосистема; ongoing decrease – продолжающееся снижение; particular contaminant – редкое, конкретное загрязняющее вещество; pollutants – загрязняющие вещества; pollution – загрязнение; public and private properties – государственная и частная собственность; relevant to – относящийся к; surface runoff – поверхностный сток; to alter soil – (видо)изменять почву; to reduce biodiversity – снижать разнообразие биологических видов; to release particulates – выбрасывать твердые частицы / взвесь; trespass – злоупотребление; turbidity (cloudiness) – мутность; xenobiotics – ксенобиотики.

***Exercise 3. Find synonyms to the words in the list below*:**

To affect, contamination, types, water, damage, capacity, control, primary treatment, aqua, monitoring, property, the first time harm, treatment, kinds, to influence / to cause effect, pollution.

***Exercise 4. Match the words, which can be both a noun and a verb, to their Russian equivalents*:**

Cause, discharge, list, subject, litter / причина, мусорить, подвергать, перечислять, освобождать/разряжать.

***Exercise 5. Match verbs to their nouns and give their Russian equivalents*:**

To pollute; ozone; effect; pollution; to subject; to affect; to ozonize; object.

Exercise 6. Read and translate the text. Say what forms of pollution exist.

The major forms of pollution are listed below along with the particular contaminant relevant to each of them. *Air pollution* means the release of chemicals and particulates into the atmosphere. Common gaseous pollutants include carbon monoxide, sulfur dioxide, chlorofluorocarbons (CFCs) and nitrogen oxides produced by industry and motor vehicles. Photochemical ozone and smog are created as nitrogen oxides and hydrocarbons react

to sunlight. *Light pollution* includes light trespass, over-illumination and astronomical interference. *Littering* means the criminal throwing of inappropriate man-made objects, unremoved, onto public and private properties. *Noise pollution* includes encompasses roadway noise, aircraft noise, industrial noise as well as high-intensity sonar. *Soil contamination* occurs when chemicals are released by spill or underground leakage. Among the most significant soil contaminants are hydrocarbons, heavy metals, herbicides, pesticides and chlorinated hydrocarbons. *Radioactive contamination*, resulting from 20th century activities in atomic physics, such as nuclear power generation and nuclear weapons research, manufacture and deployment. *Thermal pollution* is a temperature change in natural water bodies caused by human influence, such as use of water as coolant in a power plant. *Visual pollution*, which can refer to the presence of overhead power lines, motorway billboards, scarred landforms (as from strip mining), open storage of trash, municipal solid waste or space debris. *Water pollution*, by the discharge of wastewater from commercial and industrial waste (intentionally or through spills) into surface waters; discharges of untreated domestic sewage, and chemical contaminants, such as chlorine, from treated sewage; release of waste and contaminants into surface runoff flowing to surface waters (including urban runoff and agricultural runoff, which may contain chemical fertilizers and pesticides); waste disposal and leaching into groundwater; eutrophication and littering.

Exercise 7. Work in pares with the cards "Pollutants" to make up dialogues.

I. A pollutant is substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource. A pollutant may cause long- or short-term damage by changing the growth rate of plant or animal species, or by interfering with human amenities, comfort, health, or property values. Some pollutants are biodegradable and therefore will not persist in the environment in the long term. A pollutant is a waste material that pollutes air, water or soil. Three factors determine the severity of a pollutant: its chemical nature, the concentration and the persistence. There are different types of pollutants by absorptive capacity.

II. *Stock Pollutants*. Pollutants that the environment has little or no absorptive capacity are called stock pollutants (e.g. persistent synthetic chemicals, non-biodegradable plastics, and heavy metals). Stock pollutants accumulate in the environment over time. The damage they cause increases as more pollutant is emitted, and persists as the pollutant accumulates. Stock pollutants can create a burden for future generations by passing on

damage that persists well after the benefits received from incurring that damage have been forgotten.

III. *Fund Pollutants*. Fund pollutants are those for which the environment has some absorptive capacity. Fund pollutants do not cause damage to the environment unless the emission rate exceeds the receiving environment's absorptive capacity (e.g. carbon dioxide, which is absorbed by plants and oceans). Fund pollutants are not destroyed, but rather converted into less harmful substances, or diluted/dispersed to non-harmful concentrations. *Notable pollutants* include the following groups: heavy metals, persistent organic pollutants, environmental persistent pharmaceutical pollutants, polycyclic aromatic hydrocarbons, volatile organic compounds, and environmental xenobiotics.

IV. Zones of Influence. Pollutants can also be defined by their zones of influence, both horizontally and vertically. The *horizontal zone* refers to the area that is damaged by a pollutant. Local pollutants cause damage near the emission source. Regional pollutants cause damage further from the emission source. The *vertical zone* is referred to whether the damage is ground-level or atmospheric. Surface pollutants cause damage by concentrations of the pollutant accumulating near the Earth's surface Global pollutants cause damage by concentrations in the atmosphere.

Exercise 8. Match pollution causes to their health effects according to the text "Environmental Pollution Effects".

Causes		Effects
1) air pollution	a	skin irritations and rashes
2) chemical and radioactive substances	b	hearing loss, high blood pressure, and sleep disturbance
3) lead and other heavy metals	c	neurologic symptom
4) mercury	d	lung disorders and heart diseases
5) noise pollution	e	neurological problems
6) oil spills	f	cancer and birth defects

Effects on Human Health

Adverse air quality can kill many organisms including humans. Ozone pollution can cause respiratory disease, cardiovascular disease, throat inflammation, chest pain, and congestion. Water pollution causes approximately 14,000 deaths per day, mostly due to contamination of drinking water by untreated sewage in developing countries. An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrhea every day. Nearly 500 million Chinese lack access to safe drinking

water. 656,000 people die prematurely each year in China because of air pollution. In India, air pollution is believed to cause 527,700 fatalities a year. Studies have estimated that the number of people killed annually in the UK could be over 50,000.

Oil spills can cause skin irritations and rashes. Noise pollution induces hearing loss, high blood pressure, stress, and sleep disturbance. Mercury has been linked to developmental deficits in children and neurologic symptoms. Older people are majorly exposed to diseases induced by air pollution. Those with heart or lung disorders are under additional risk. Children and infants are also at serious risk. Lead and other heavy metals have been shown to cause neurological problems. Chemical and radioactive substances can cause cancer and as well as birth defects.

Effects on Environment

Pollution has been found to be present widely in the environment. There are a number of effects of this. Carbon dioxide emissions cause ocean acidification, the ongoing decrease in the pH of the Earth's oceans as CO_2 becomes dissolved. The emission of greenhouse gases leads to global warming which affects ecosystems in many ways. Invasive species can out compete native species and reduce biodiversity. Invasive plants can contribute debris and biomolecules (allelopathy) that can alter soil and chemical compositions of an environment, often reducing native species competitiveness. Nitrogen oxides are removed from the air by rain and fertilise land which can change the species composition of ecosystems. Smog and haze can reduce the amount of sunlight received by plants to carry out photosynthesis and leads to the production of tropospheric ozone which damages plants. Soil can become infertile and unsuitable for plants. Sulfur dioxide and nitrogen oxides can cause acid rain which lowers the pH value of soil.

Greenhouse gases and global warming

Carbon dioxide, while vital for photosynthesis, is sometimes referred to as pollution, because raised levels of the gas in the atmosphere are affecting the Earth's climate. Disruption of the environment can also highlight the connection between areas of pollution that would normally be classified separately, such as those of water and air. Recent studies have investigated the potential for long-term rising levels of atmospheric carbon dioxide to cause slight but critical increases in the acidity of ocean waters, and the possible effects of this on marine ecosystems.

Exercise 9. Read and translate the text below. Say what practice of pollution control is the most effective to your point of view.

Regulation and Monitoring of Pollution

Pollution control is a term used in environmental management. It means the control of emissions and effluents into air, water or soil. Without pollution control, the waste products from consumption, heating, agriculture, mining, manufacturing, transportation and other human activities, whether they accumulate or disperse, will degrade the environment. In the hierarchy of controls, pollution prevention and waste minimization are more desirable than pollution control. In the field of land development, low impact development is a similar technique for the prevention of urban runoff.

Pollution control practices recycling, reusing, reducing, mitigating, preventing, compost. Its devices are *dust collection systems* (baghouses, cyclones, electrostatic precipitators), *scrubbers* (baffle spray scrubber, cyclonic spray scrubber, ejector venturi scrubber, mechanically aided scrubber, spray tower, wet scrubber), *sewage treatment* (sedimentation (primary treatment), activated sludge biotreaters (secondary treatment; also used for industrial wastewater), aerated lagoons, constructed wetlands (also used for urban runoff)), and *industrial wastewater treatment* (api oil-water separators, biofilters, dissolved air flotation).

To protect the environment from the adverse effects of pollution, many nations worldwide have enacted legislation to regulate various types of pollution as well as to mitigate the adverse effects of pollution. Pollutants can cross international borders and therefore international regulations are needed for their control.

The Stockholm Convention on Persistent Organic Pollutants (2004) is an international legally binding agreement for the control of persistent organic pollutants.

Pollutant Release and Transfer Registers (PRTR) are systems to collect and disseminate information on environmental releases and transfers of toxic chemicals from industrial and other facilities.

The European Pollutant Emission Register is a type of PRTR providing access to information on the annual emissions of industrial facilities in the Member States of the European Union, as well as Norway.

The Resource Conservation and Recovery Act (RCRA) regulates the management, transport and disposal of municipal solid waste, hazardous waste and underground storage tanks.

***Exercise 10. Answer the following questions*:**

1. What types of pollutants by absorptive capacity do you know? 2. What is the main difference between light and noise pollution? 3. How many factors determine the severity of a pollutant? 4. Persistent synthetic chemicals, non-biodegradable plastics, and heavy metals are known to be stock pollutants, aren't they? 5. For which pollutants the environment has some absorptive capacity?

Exercise 11. Speak on the topic "Environmental Pollution".

UNIT IX

SOLUTION FOR AIR POLLUTION

***Exercise 1. Read and memorize the following words of this unit*:**

Abatement – борьба; acid rain – кислотный дождь; acidification – окисление; ambient air – температура воздуха; animal tissue – животная ткань; anthropogenic pollutants – антропогенные загрязнители; anthropogenic sources – антропогенные источники; asphyxiant – удушающий газ; attainment – достижение; averaged – усредненный; basement – подвал; biting odor – едкий запах; blower – вентилятор; carcinogens – канцерогены; caustic – каустик; chlorofluorocarbons – хлорфторуглероды; controlled fire – управление огнем; conversion to cleaner fuels – преобразование в экологически чистые виды топлива; crop waste – отходы земледелия; displacement – перемещение; disposable – одноразовый; dung – навоз; duration of activity – продолжительность деятельности; electrostatic precipitators – электрофильтры; enhanced – расширенный; flammable – горючее, воспламенимый; flue gas – дымовой газ; fossil fuel – ископаемое топливо; fume – дым; furnaces – печи; germination – прорастание; greenhouse effect – парниковый эффект; hazardous – опасный; haze – дымка; health hazard – опасность для здоровья; heavy dust loads – тяжелый мусор; landfills – свалки; liquid droplets – капли жидкости; multicyclones – мультициклоны; natural sources – природные источники; noble gas – благородный газ; nuclear explosions – ядерные взрывы; nutritional needs of terrestrial organisms – пищевые потребности живых организмов; ozone depletion – истощение озонового слоя; persistent free radicals – устойчивые свободные радикалы; photochemical smog – фотохимический смог; photolytic process – фотолитический процесс (процесс разрушения под воздействием светового излучения); plume downwind of cities – шлейф с подветренной стороны города; portmanteau – производное; prairie restoration – восстановление прерий; precursor to foodstuffs – предшественник пищевых продуктов; primary pollutants release – выброс загрязняющих веществ;prolonged exposure – длительное воздействие; prominent pollutants – видимые загрязняющие вещества; pungent odor – резкий запах; radioactive decay of radon – радиоактивный распад радона; schematic drawing – чертеж; smoke stacks of power plants – дымовые трубы электростанций; stationary sources – стационарные источники; suffocation – удушье; sulphur dioxide – двуокись серы (сернистый газ); synthe-

sis of pharmaceuticals – синтез лекарственных средств; tiny particles of solid – крошечные частицы твердого вещества; to bioaccumulate – накапливать биологически; to biomagnify in food chains – усиливаться биологически в пищевых цепях; to burn fuel – сжигать топливо; to persist in – существовать в; to remove a pollutant – удалять загрязняющее вещество; toluene – толуол; UV radiation – ультрафиолетовое излучение; vehicular and industrial emissions – автомобильные и промышленные выбросы; vehicular exhaust – автомобильный выхлоп; volatile organic compounds – летучие органические соединения; waste incinerators – установки для сжигания отходов; xylene – ксилол.

***Exercise 2. Match substances to their chemical formulas*:**

Ammonia, carbon monoxide, carbon dioxide, methane, nitrogen dioxide, sulphur dioxide / CH_4, CO, CO_2, NH_3, NO_2, SO_2.

***Exercise 3. Compose word combinations matching the words in columns*:**

coal, sprays, deposition, contamination, schematic, impact, ocean, wet	burning, aerosol, waste, particulate, drawing, environmental, acidification, scrubber

***Exercise 4. Match adjectives to their nouns and give their Russian equivalents*:**

Responsible, sulfuric, hazardous, gaseous, asphyxiant, response, sulfur, hazard, gas, asphyxia.

Exercise 5. Read and translate the text. Say what anthropogenic and natural sources of air pollution you know.

Sources of air pollution refer to the various locations, activities or factors which are responsible for the releasing of pollutants into the atmosphere. These sources can be classified into two major categories which are anthropogenic sources and natural sources.

Anthropogenic Sources of Air Pollution

Anthropogenic sources (human activity) are mostly related to burning different kinds of fuel listed below. *Stationary sources* include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices. In developing and poor countries, traditional biomass burning is the major source of air pollutants; traditional biomass includes wood, crop waste and dung. *Mobile sources* include motor vehicles, marine vessels, aircraft and

the effect of sound. *Chemicals*, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest. *Fumes* from paint, hair spray, varnish, aerosol sprays and other solvents *Waste* deposition in landfills, which generate methane. Methane is not toxic, however, it is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement.

Natural Sources of Air Pollution

Natural sources, listed below, are related to dust from natural sources, usually large areas of land with little or no vegetation. *Methane*, emitted by the digestion of food by animals, for example, cattle. *Radon gas* from radioactive decay within the Earth's crust is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking. *Smoke* and carbon monoxide from wildfires. *Vegetation*, in some regions, emits environmentally significant amounts of volatile organic compounds (VOCs) on warmer days. These VOCs react with primary anthropogenic pollutants – specifically, NO_2, SO_2, and anthropogenic organic carbon compounds – to produce a seasonal haze of secondary pollutants. *Volcanic activity* produces sulfur, chlorine, and ash particulates.

Exercise 6. Read and translate the text "Air Pollutants" and match air pollution causes to their effects according to it.

	Causes		Effects
1)	emission from products currently banned from use	a	discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment
2)	vehicular and industrial emissions that are acted on in the atmosphere by ultravi-	b	greenhouse effect, particulate contamination, acid rain, increased ground level ozone concentration,

	olet light from the sun to form secondary pollutants that also combine with the primary emissions		increased levels of nitrogen oxides
3)	introduction into the atmosphere of chemicals	c	acid rain
4)	oxidation of sulphur dioxide in the presence of a catalyst	d	smoke and fog
5)	large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide	e	photochemical smog
6)	schematic drawing	f	chlorofluorocarbons

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment. The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystem. Schematic drawing, causes and effects of air pollution are greenhouse effect, particulate contamination, increased UV radiation, acid rain, increased ground level ozone concentration, increased levels of nitrogen oxides.

A substance in the air that can be harmful to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone – one of the many secondary pollutants that make up photochemical smog. Some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

Primary Air Pollutants

Major primary pollutants produced by human activity include the following substances. *Sulfur oxides* (SO_x) – especially sulphur dioxide, a chemical compound with the formula SO_2. SO_2 is produced by volcanoes

and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources. *Nitrogen oxides* (NO_x), especially nitrogen dioxide, are emitted from high temperature combustion, and are also produced naturally during thunderstorms by electric discharge. They can be seen as the brown haze dome above or plume downwind of cities. Nitrogen dioxide is the chemical compound with the formula NO_2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor. NO_2 is one of the most prominent air pollutants. *Carbon monoxide* (CO) is a colourless, odorless, non-irritating but very poisonous gas. It is produced by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide. *Carbon dioxide* (CO_2) – a colourless, odorless, non-toxic greenhouse gas also associated with ocean acidification, emitted from sources such as combustion, cement production, and respiration. It is otherwise recycled in the atmosphere in the carbon cycle. *Volatile organic compounds* (VOCs) are an important outdoor air pollutant. In this field they are often divided into the separate categories of methane (CH_4) and non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead to leukemia through prolonged exposure. 1,3-butadiene is another dangerous compound which is often associated with industrial uses. *Particulates*, alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulates can be man made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols – those made by human activities – currently account for about 10 percent of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and

lung cancer. *Persistent free radicals* connected to airborne fine particles could cause cardiopulmonary disease. *Toxic metals*, such as lead, cadmium, and copper. *Chlorofluorocarbons* (CFCs) are harmful to the ozone layer emitted from products currently banned from use. *Ammonia*, a compound with the formula NH_3, is emitted from agricultural processes. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous. *Radioactive pollutants* are produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.

Secondary Air Pollutants

Secondary pollutants include the following substances. *Particulates* created from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

Minor Air Pollutants

Minor air pollutants include the following substances. A large number of *minor hazardous air pollutants*. A variety of *persistent organic pollutants* can attach to particulates. *Persistent organic pollutants* (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment.

Exercise 7. Work in pares with the cards "Health effects" to make up dialogues.

I. Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, and lung cancer. The health effects caused by air pollution may include difficulty in breathing,

wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death.

II. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics.

III. The most common sources of air pollution include particulates, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and outdoor air pollution have caused approximately 3.3 million deaths worldwide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution.

IV. The World Health Organization states that 2.4 million people die each year from causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution. A study by the University of Birmingham has shown a strong correlation between pneumonia related deaths and air pollution from motor vehicles. Worldwide more deaths per year are linked to air pollution than to automobile accidents. A 2005 study by the European Commission calculated that air pollution reduces life expectancy by an average of almost nine months across the European Union. Causes of deaths include aggravated asthma, emphysema, lung and heart diseases, and respiratory allergies. It was estimated that a proposed set of changes in diesel engine technology could result in 12,000 fewer premature mortalities, 15,000 fewer heart attacks, 6,000 fewer emergency room visits by children with asthma, and 8,900 fewer respiratory-related hospital admissions each year all over the world.

V. The number of annual premature deaths is considerably higher than the fatalities related to auto collisions in the same area, which average fewer than 2,000 per year. Diesel exhaust (DE) is a major contributor to combustion derived particulate matter air pollution. In several human experimental studies, using a well validated exposure chamber setup, DE has been linked to acute vascular dysfunction and increased thrombus formation.

VI. Oxygen comprises 21% of the Earth's atmosphere. It is lucky for us that this is the case. If it was any lower than 17% we would not be able to breathe; and if it was over 25% all of the organic material would be highly flammable. How fortunate then that at 21% it lies exactly between these two limiting values.

Exercise 8. Read and translate the text on monitoring air pollution. Say what factors are the most harmful to your point of view.

Air Pollutant Emission Factors

Air pollutant emission factors are representative values that people attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per tone of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages.

Air Pollution Reduction Efforts

There are various air pollution control technologies and land use planning strategies available to reduce air pollution. At its most basic level land use planning is likely to involve zoning and transport infrastructure planning. In most developed countries, land use planning is an important part of social policy, ensuring that land is used efficiently for the benefit of the wider economy and population as well as to protect the environment.

Efforts to reduce pollution from mobile sources includes primary regulation (many developing countries have permissive regulations), expanding regulation to new sources (such as transport ships, farm equipment, and small gas-powered equipment such as lawn trimmers, chainsaws, and snowmobiles), increased fuel efficiency (such as through the use of hybrid vehicles), conversion to cleaner fuels (such as bioethanol, biodiesel, or conversion to electric vehicles).

Air Pollution Control devices

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

1. Particulate control

Mechanical collectors. The most common are dust cyclones and multicyclones. *Electrostatic precipitators*. An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulates such as dust and smoke from the air stream.

Bag houses. Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust). *Particulate scrubbers*. Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

2. Legal regulation

In general, there are two types of air quality standards. The first class of standards, like the E.U. Air Quality Directive, sets maximum atmospheric concentrations for specific pollutants. Environmental agencies enact regulations which are intended to result in attainment of these target levels. The second class, like The North American Air Quality Index, is used to communicate to the public the relative risk of outdoor activity. The scale may or may not distinguish between different pollutants.

***Exercise 9. Answer the following questions*:**

1. What are air pollutant emission factors representative to? 2. What activity is the release of air pollutant associated with? 3. The weight of pollutant divided by a unit weight, speed, distance, or duration of the activity emitting the pollutant are regarded as air pollutant emission factors. What factor of this list is false? 4. Which class of air quality standards is used to communicate to the public the relative risk of outdoor activity? 5. Why has stratospheric ozone depletion been recognized as a threat to human health?

Exercise 10. Speak on the topic "Solution for Air Pollution".

UNIT X

SOLUTION FOR WATER POLLUTION

***Exercise 1. Read and memorize the following words of this unit*:**

Acid mine drainage – кислотный шахтный дренаж; acidity – кислотность; algae bloom – цветение морских водорослей; anaerobic lagoons – анаэробные лагуны; anoxia (oxygen depletion) – кислородное голодание (кислородное истощение); anthropogenic substance – антропогенное вещество; aquifers – водоносные слои; bioassays – биоприборы; biosurveys (population counts) – биообзоры (количество населения); biotic communities – биологические виды; bush debris from logging operations – обрезки древесины с лесозаготовок; cadmium – кадмий; cloudiness – мутность; containment – удерживание; cooling ponds – охлаждение водоемов; cumulative effect – суммарный эффект; dense liquids – плотные жидкости; detergents – моющие средства; discarded trash – хлам, от которого отказываются; ditch – сажать в аварийном режиме; domestic sewage – бытовые сточные воды; rubbish – мусор; drain – утечка; earthquake – землетрясение; effluent – сточные воды; electrical conductivity – электрическая проводимость; eutrophication – эвтрофикация (цветение воды в результате повышенной концентрации в ней биогенных веществ, т. е. азота и фосфора); floatables – плавающие твердые частицы; fuel combustion byproducts – побочные продукты сжигания топлива; fuel oil – горючее; garbage – отбросы; grab samples – взятые образцы / пробы; grease – жир, смазывать жиром; hydraulic capacity – гидравлическая способность; to implement – реализовывать; in situ – на месте; individual aquifers and wells – отдельные водоносные слои и колодцы; industrial solvents – промышленные растворители; irrelevant – несоответствующий, не важный; jet fuel – реактивное топливо; lead – свинец; leaky sewage collection system – прохудившаяся система сбора сточных вод; lubricant – смазка; nonpoint source pollution – рассредоточенные источники загрязнения; nutrient runoff – питательный сток; ocean acidification – подкисление океана; oxygen depletion – кислородное истощение; oxygen-depleting substances – исчерпывающие кислород вещества; personal hygiene – личная гигиена; to pipe – перекачивать по трубопроводу; point source pollution – локальное загрязнение; pollution prevention – предотвращение загрязнения; publicity owned treatment works – принадлежащее государству очистное сооружение; to pump – качать;

radionuclide contaminant – радионуклидный загрязнитель; release of water – выпуск воды; residential use – жилое использование; riparian buffers – прибрежные буфера; sampling of water – забор проб воды; sanitary sewer overflow – санитарное переполнение коллектора; sensory changes – сенсорные изменения; severe reductions – серьезные сокращения; sewage treatment plant – станция очистки сточных вод; sheet flow – технологическая схема; sludge – ил; slurries – жидкие растворы; thermal pollution – тепловое загрязнение; thermophilic species – теплолюбивые разновидности; to diffuse contamination – распространять загрязнение; to eliminate – устранение; to facilitate – способствовать; to impair – вредить; to validate – проверять; toxic pollutants – токсичные загрязнители; toxicity – токсичность; trickle – струйка; turbidity – помутнение; valve – клапан; via urban storm water runoff – через городскую ливневую канализацию; volatile organic compounds – изменчивые органические соединения; vs. (лат.) – против; wetlands – заболоченные места.

***Exercise 2. Match the words combinations to their Russian equivalents*:**

Fuel, groundwater pollution, microbial testing of drinking water, processing waste, toxic substances / топливо, микробиологический анализ питьевой воды, загрязнение подземных вод, токсичные вещества, обработка отходов.

***Exercise 3. Compose word combinations matching the words below*:**

Pollution, species, drinking, algae, runoff, contaminants, toxin, prevention, individual, water, blooms, nutrient, radionuclide, plume.

***Exercise 4. Find out derivative adjectives of which nouns were lost and give their Russian equivalents*:**

Phenomena, bacteria, identification, nutrient, acidity, identifiable, susceptible, nutrient, soil.

Exercise 5. Read and translate the text. Say what water pollution categories are known.

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not

support a human use, such as drinking water drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water.

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (international down to individual aquifers and wells). It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily.

Water Pollution Categories

Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated. Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources. Sources of surface water pollution are generally grouped into two categories based on their origin.

Point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

Nonpoint source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. This pollution is often the cumulative effect of small amounts of contaminants gathered from a large area. A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in stormwater from "sheet flow" over an agricultural field or forest is also cited as examples of NPS pollution.

Groundwater Pollution

Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, sometimes referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. non-point source may be irrelevant. A spill or ongoing releases of chemical or radionuclide contaminants into soil (located away from a surface water body) may not create point source or non-point source pollution, but can contaminate the aquifer below, defined as a toxin plume. The movement of the plume, called a plume front, may be analyzed

through a hydrological transport model or groundwater model. Analysis of groundwater contamination may focus on the soil characteristics and site geology, hydrogeology, hydrology, and the nature of the contaminants.

Exercise 6. Read and translate the text "Water Pollution Causes" and match pollution causes to their effects according to it.

	Causes		Effects
1)	anthropogenic substances	a	fish and other animal populations
2)	coliform bacteria, i. e. a used bacterial indicator of water pollution	b	waterborne diseases in either human or animal hosts
3)	industrial discharges (especially sulfur dioxide from power plants)	c	although not an actual cause of disease
4)	leaky sewage collection systems (pipes, pumps, valves)	d	turbidity blocks light, disrupts plant growth, and clogs the gills of some fish species
5)	oxygen depletion and severe reductions in water quality	e	sanitary sewer overflows
6)	pathogens	f	acidity

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant. High concentrations of naturally occurring substances can have negative impacts on aquatic flora and fauna. Oxygen-depleting substances may be natural materials, such as plant matter (e.g. leaves and grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species.

Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry includes acidity (change in pH), electrical conductivity, temperature, and eutrophication. Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases in the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia

(oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations.

Pathogens

Coliform bacteria are a commonly used bacterial indicator of water pollution, although not an actual cause of disease. Other microorganisms sometimes found in surface waters which have caused human health problems include: *Burkholderia pseudomallei*, *Cryptosporidium parvum*, *Giardia lamblia*, *Salmonella*, *Novovirus* and other viruses, parasitic worms (helminths).

High levels of pathogens may result from inadequately treated sewage discharges. This can be caused by a sewage plant designed with less than secondary treatment (more typical in less-developed countries). In many countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can cause sanitary sewer overflows. Some cities also have combined sewers, which may discharge untreated sewage during rain storms. Pathogen discharges may also be caused by poorly managed livestock operations.

Chemical and other contaminants

Contaminants may include organic and inorganic substances. *Organic water pollutants* include: 1) detergents; 2) disinfection by products found in chemically disinfected drinking water, such as chloroform; 3) food processing waste, which can include oxygen-demanding substances, fats and grease; 4) insecticides and herbicides, a huge range of organohalides and other chemical compounds; 5) petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil), lubricants (motor oil), and fuel combustion byproducts from stormwater runoff; 6) tree and bush debris from logging operations; 7) volatile organic compounds, such as industrial solvents, from improper storage; 8) various chemical compounds found in personal hygiene and cosmetic products. Chlorinated solvents, which are dense non-aqueous phase liquids, may fall to the bottom of reservoirs, since they don’t mix well with water and are denser (polychlorinated biphenyl, trichloroethylene).

Inorganic water pollutants include: 1) acidity caused by industrial discharges (especially sulfur dioxide from power plants); 2) ammonia from food processing waste; 3) fertilizers containing nutrients – nitrates and phosphates – which are found in stormwater runoff from agriculture, as well as commercial and residential use; 4) heavy metals from motor vehicles (via urban stormwater runoff) and acid mine drainage; 5) sediment in

runoff from construction sites, logging, slash and burn practices or land clearing sites.

Thermal pollution

Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. Unlike chemical pollution, it results in a change in the physical properties of water. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Elevated water temperatures decreases oxygen levels (which can kill fish) and affects ecosystem composition, such as invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters. Thermal pollution can also be caused by the release of very cold water from the base of reservoirs into warmer rivers.

Macroscopic pollution

Macroscopic pollution, i. e. large visible items, polluting the urban stormwater, or marine debris when found on the open seas, can include such items as: trash or garbage (e.g. paper, plastic, or food waste) discarded by people on the ground, along with accidental or intentional dumping of rubbish, that are washed by rainfall into storm drains and eventually discharged into surface waters.

Exercise 7. Work in pares with the cards "Measurement" to make up dialogues.

I. Water pollution may be analyzed through several broad categories of methods: physical, chemical and biological. Most involve collection of samples, followed by specialized analytical tests. Some methods may be conducted *in situ*, without sampling, such as temperature. Government agencies and research organizations have published standardized, validated analytical test methods to facilitate the comparability of results from disparate testing events.

II. *Sampling* of water for physical or chemical testing can be done by several methods, depending on the accuracy needed and the characteristics of the contaminant. Many contamination events are sharply restricted in time, most commonly in association with rain events. For this reason "grab" samples are often inadequate for fully quantifying contaminant levels. Scientists gathering this type of data often employ auto-sampler devices that pump increments of water at either time or discharge intervals. Sampling for biological testing involves collection of plants and/or animals from the surface water body. Depending on the type of assessment, the organisms may be

identified for biosurveys (population counts) and returned to the water body, or they may be dissected for bioassays to determine toxicity.

III. *Chemical testing* (i. e. water chemistry analysis and environmental chemistry). Water samples may be examined using the principles of analytical chemistry. Many published test methods are available for both organic and inorganic compounds. Frequently used methods include pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients (nitrate and phosphorus compounds), metals (including copper, zinc, cadmium, lead and mercury), oil and grease, total petroleum hydrocarbons (TPH), and pesticides.

IV. *Biological testing* (Bioindicator) involves the use of plant, animal, and/or microbial indicators to monitor the health of an aquatic ecosystem. Bacteriological water analysis is for microbial testing of drinking water. Common *physical tests* of water include temperature, solids concentrations (e. g., total suspended solids (TSS)) and turbidity.

Exercise 8. Read and translate the text "Control of Water Pollution". Say what of three water pollution monitoring treatments is the most important to your point of view.

Domestic sewage

Domestic sewage is 99.9 percent pure water, while the other 0.1 percent is pollutants. Although found in low concentrations, these pollutants pose risk on a large scale. In urban areas, domestic sewage is typically treated by centralized sewage treatment plants. All over the world, most of these plants are operated by local government agencies, frequently referred to as publicly owned treatment works. Municipal treatment plants are designed to control conventional pollutants: BOD and suspended solids. Well-designed and operated systems (i. e., secondary treatment or better) can remove 90 percent or more of these pollutants. Some plants have additional sub-systems to treat nutrients and pathogens. Most municipal plants are not designed to treat toxic pollutants found in industrial wastewater.

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including: 1) utilizing a green infrastructure approach to improve stormwater management capacity throughout the system, and reduce the hydraulic overloading of the treatment plant; 2) repair and replacement of leaking and malfunctioning equipment; 3) increasing overall hydraulic capacity of the sewage collection system. A household or business not served by a municipal treatment plant may have an individual sep-

tic tank, which treats the wastewater on site and discharges into the soil. Alternatively, domestic wastewater may be sent to a nearby privately owned treatment system.

Industrial wastewater

Some industrial facilities generate ordinary domestic sewage that can be treated by municipal facilities. Industries that generate wastewater with high concentrations of conventional pollutants (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or other non-conventional pollutants such as ammonia, need specialized treatment systems. Some of these facilities can install a pre-treatment system to remove the toxic components, and then send the partially treated wastewater to the municipal system. Industries generating large volumes of wastewater typically operate their own complete on-site treatment systems. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention. Heated water generated by power plants or manufacturing plants may be controlled with: 1) cooling ponds, man-made bodies of water designed for cooling by evaporation, convection, and radiation; 2) cooling towers, which transfer waste heat to the atmosphere through evaporation and/or heat transfer; 3) cogeneration, a process where waste heat is recycled for domestic and/or industrial heating purposes.

Agricultural wastewater

There are two types of agricultural wastewater treatment. *Nonpoint source wastewater treatment*. Sediment (loose soil) washed off fields is the largest source of agricultural pollution. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers. Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer; animal manure; or spraying of municipal or industrial wastewater (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife, and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients. *Point source wastewater treatment*. Farms with large livestock and poultry operations, such as factory farms, are called concentrated animal feeding operations or feedlots and are subject to increasing government regulation. Animal slurries are usually treated by containment in anaerobic lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes.

***Exercise 9. Answer the following questions*:**

1. What industries need specialized treatment systems? 2. What is the agricultural application of nutrients (nitrogen and phosphorus)? 3. Food processing waste can include oxygen-demanding substances, fats and grease, and herbicides. What of this list is false? 4. Chemical pollution, unlike thermal, results in a change in the physical properties of water, doesn't it? 5. Why is groundwater pollution not easily classified, unlike surface water pollution?

Exercise 10. Speak on the topic "Solution for Water Pollution".

UNIT XI

SOLUTION FOR SOIL CONTAMINATION

***Exercise 1. Read and memorize the following words of this unit*:**

Arsenic – мышьяк; arthropods resident – членистоногие; auxins – ауксины; avian consumers – потребители птицы; to biodegrade – разлагать биологически; bioremediation – биологическое восстановление; biosolids – твердые вещества биологического происхождения; biostimulation – биостимуляция; capping – укупоривание; carcinogenic – канцерогенный; hazardous waste – опасные отходы; chick mortality – детская смертность; chlorinated solvents – хлорированные растворители; chronic exposure – хроническое облучение; coal ash – угольная зола; coal slag bubbly – угольный пенящийся шлак; contaminated surface water – загрязненные поверхностные воды; deleterious consequences – пагубные последствия; disposal site – захоронения; drainage – дренаж, канализация; dredging of bay muds – углубление грязи бухты; electrical resistance heating – электрические нагревательные сопротивления; endemic microorganism – эндемичный микроорганизм; environmental remediation (clean up) – восстановление окружающей среды, очистка; extinction of species – вымирание видов; extractable lead – извлекаемый свинец; food chain – пищевая цепочка; gray heterogeneous soil – серая однородная почва; incidence – сфера, наклон; infiltration – инфильтрация; ingestion of contaminants – прием загрязняющих веществ; landfills – закапывание мусора; languishing crops – вялые зерновые культуры; leaching – выщелачивание; long half-lives – длительный период полураспада; mammals – млекопитающие; mapping – картография; microbial digestion – микробное переваривание; mollusk – моллюск; nematode (roundworm) – нематода (круглый червь); pavement – покрытие; persistent materials – стойкие материалы; pests – вредители; phytoremediation – фиторемедиации (комплекс методов очистки грунтов, сточных вод и атмосферного воздуха с использованием зеленых растений); piping – трубопровод; pathogen – болезнетворный микроорганизм; potential extinction of species – потенциальное исчезновение разновидностей; predator – хищник; reduction in crop yields – снижение урожайности; soil contamination – загрязнение почвы; soil conservation – сохранение почвы; storage tanks – резервуары для хранения; to alter plant metabolism – изменить метаболизм растения; to be a vector for disease – быть вектором для

болезни; to cause a nuisance − вызвать неприятность; to manifest in the alteration of metabolism − проявляться в изменении метаболизма; to shield soil from erosion − оградить почву от эрозии; to volatilize – испаряться; vesicular pebble-sized grains – везикулярное зерно размером с гальку; virtual eradication – фактическая ликвидация; weed – сорняк; white grains – белые зерна; weakening of egg shells – ослабление яичной скорлупы; willow – ива.

***Exercise 2. Match the words combinations to their Russian equivalents*:**

Intensity of chemical usage; leaching from landfills; bay muds containing toxins; hazardous waste; microbial digestion of organic chemicals.

***Exercise 3. Complete word combinations with the prepositions against, by, for, for, of, out of*:**

Strategies … remediation; used … residential and industrial heating; application … fertilizers; caused … corrosion; to volatize chemical contaminants … the soil; used … any pest.

***Exercise 4. Give Russian equivalents for the following terms*:**

Environmental remediation; phytoremediation; extinction of species; virtual eradication.

***Exercise 5. Read and translate the text*:**

Soil Contamination

Soil contamination or soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste. The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents, pesticides, lead, and other heavy metals. Contamination is correlated with the degree of industrialization and intensity of chemical usage.

The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapors from the contaminants, and from secondary contamination of water supplies within and underlying the soil. Mapping of contaminated soil sites and the resulting cleanup are time consuming and expensive tasks, requiring extensive amounts of geology, hydrology, chemistry, computer modeling skills, as well as an appreciation of the history of industrial chemistry.

Soil contamination can be caused by: 1) corrosion of underground storage tanks (including piping used to transmit the contents); 2) application of pesticides and fertilizers; mining; 3) oil and fuel dumping; 4) disposal of coal ash; 5) leaching from landfills; 6) direct discharge of industrial wastes to the soil; 7) drainage of contaminated surface water into the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead, and other heavy metals.

Clean up or environmental remediation is analyzed by environmental scientists who utilize field measurement of soil chemicals and also apply computer models for analyzing transport and fate of soil chemicals. There are several principal strategies for remediation. 1. Excavate soil and take it to a disposal site away from ready pathways for human or sensitive ecosystem contact. This technique also applies to dredging of bay muds containing toxins. 2. Aeration of soils at the contaminated site (with attendant risk of creating air pollution). 3. Thermal remediation by introduction of heat to raise subsurface temperatures sufficiently high to volatize chemical contaminants out of the soil for vapour extraction. Technologies include electrical resistance heating (ERH). 4. Bioremediation, involving microbial digestion of certain organic chemicals. Techniques used in bioremediation include landfarming, biostimulation with commercially available microflora. 5. Extraction of groundwater or soil vapor with an active electromechanical system, with subsequent stripping of the contaminants from the extract. 6. Containment of the soil contaminants. 7. Phytoremediation, or using plants (such as willow) to extract heavy metals.

Exercise 6. Give your definition of soil contamination and say what strategies for environmental remediation are the most effective to your point of view.

***Exercise 7. Answer the following questions*:**

1. What can soil pollution be caused by? 2. Give the examples of the most common chemicals. 3. Who deals with the environmental remediation? 4. How many strategies for remediation are there? 5. What technologies are used for cleaning up soil? 6. What do ecologists need for mapping of contaminated soil sites and the resulting cleanup?

Exercise 8. Read and translate the text "Soil Contamination causes" and make up dialogues.

I. Coal ash. Historical deposition of coal ash used for residential, commercial, and industrial heating, as well as for industrial processes such

as ore smelting, were a common source of contamination in areas that were industrialized before about 1960. Coal naturally concentrates lead and zinc during its formation, as well as other heavy metals to a lesser degree. When the coal is burned, most of these metals become concentrated in the ash (the principal exception being mercury). Coal ash and slag may contain sufficient lead to qualify as a "characteristic hazardous waste" because they contain more than 5 mg/L of extractable lead.

II. In addition to lead, coal ash typically contains variable but significant concentrations of polynuclear aromatic hydrocarbons (PAHs) e.g., benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(cd)pyrene, phenanthrene, and anthracene. These PAHs are known human carcinogens and the acceptable concentrations of them in soil are typically around 1 mg/kg. Coal ash and slag can be recognized by the presence of off white grains in soil, gray heterogeneous soil, or (coal slag) bubbly, vesicular pebble-sized grains.

III. *Sewage*. Treated sewage sludge, known in the industry as biosolids, has become controversial as a fertilizer to the land. As it is the byproduct of sewage treatment, it generally contains more contaminants such as organisms, pesticides, and heavy metals than other soil.

IV. *Pesticides*. A pesticide is a substance or mixture of substances used to kill a pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, molusks, birds, mammals, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other organisms.

V. *Herbicides* are used to kill weeds, especially on pavements and railways. They are similar to auxins and most are biodegrade by soil bacteria. Another herbicide is Paraquat. It is highly toxic but it rapidly degrades in soil due to the action of bacteria and does not kill soil fauna. Insecticides are used to rid farms of pests which damage crops. The insects damage not only standing crops but also stored ones. And in the tropics it is reckoned that one third of the total production is lost during food storage. As with fungicides, the first insecticides used in the nineteenth century were inorganic, e.g. compounds of arsenic. Nicotine has also been used since the late eighteenth century

Exercise 9. Read and translate the text "Soil Contamination effects" and match pollution causes to their effects according to it.

Causes		Effects
1) the concentration of persistent DDT materials for avian consumers	a	chronic carcinogenic exposure, congenital disorders or other chronic health conditions
2) sufficient dosages of a large number of soil contaminants	b	higher incidence of leukemia
3) organophosphates and carbomates	c	high incidences of kidney damage, some irreversible
4) mercury and cyclodienes	d	neuromuscular blockage
5) chronic exposure to benzene at sufficient concentrations	e	liver changes, kidney changes and depression of the central nervous system
6) chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations	f	death by exposure via direct contact, inhalation or ingestion of contaminants in groundwater contaminated through soil
7) chlorinated solvents	g	weakening of egg shells, increased chick mortality and potential extinction of species

Health Effects

Contaminated or polluted soil directly affects human health through direct contact with soil or via inhalation of soil contaminants which have vaporized; potentially greater threats are posed by the infiltration of soil contamination into groundwater aquifers used for human consumption, sometimes in areas apparently far removed from any apparent source of above ground contamination.

Health consequences from exposure to soil contamination vary greatly depending on pollutant type, pathway of attack and vulnerability of the exposed population. Chronic exposure to chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations can be carcinogenic; can cause congenital disorders or other chronic health conditions. Industrial or man-made concentrations of naturally occurring substances, such as nitrate and ammonia associated with livestock manure from agricultural operations, have also been identified as health hazards in soil and groundwater.

Chronic exposure to benzene at sufficient concentrations is known to be associated with higher incidence of leukemia. Mercury and cyclodienes are known to induce higher incidences of kidney damage, some irreversible. Organophosphates and carbonates can induce a chain of responses leading to neuromuscular blockage. Many chlorinated solvents induce liver changes, kidney changes and depression of the central nervous system. There is an entire spectrum of further health effects such as headache, nausea, fatigue, eye irritation and skin rash for the above cited and other chemicals. At sufficient dosages a large number of soil contaminants can cause death by exposure via direct contact, inhalation or ingestion of contaminants in groundwater contaminated through soil.

Ecosystem Effects

Not unexpectedly, soil contaminants can have significant deleterious consequences for ecosystems. There are radical soil chemistry changes which can arise from the presence of many hazardous chemicals even at low concentration of the contaminant species. These changes can manifest in the alteration of metabolism of endemic microorganisms and arthropods resident in a given soil environment. The result can be virtual eradication of some of the primary food chain, which in turn could have major consequences for predator or consumer species. Even if the chemical effect on lower life forms is small, the lower pyramid levels of the food chain may ingest alien chemicals, which normally become more concentrated for each consuming rung of the food chain. Many of these effects are now well known, such as the concentration of persistent dichloro-diphenyl-trichloroethane (DDT) materials for avian consumers, leading to weakening of egg shells, increased chick mortality and potential extinction of species.

Effects occur to agricultural lands which have certain types of soil contamination. Contaminants typically alter plant metabolism, often causing a reduction in crop yields. This has a secondary effect upon soil conservation, since the languishing crops cannot shield the Earth’s soil from erosion. Some of these chemical contaminants have long half-lives.

***Exercise 10. Answer the following questions*:**

1. What makes health consequences from exposure to soil contamination vary? 2. What plant metabolism can soil contamination alter? 3. Are industrial or man-made concentrations of naturally occurring substances identified as health hazards? 4. Nicotine and compounds of arsenic are proved to have been used as the first herbicides, aren’t they? 5. What several principal strategies for remediation were offered by environmental scientists who

utilize field measurement of soil chemicals and apply computer models for analyzing transport and fate of soil chemicals? 6. Environmental scientists study chemical effect on lower life forms, utilize field measurement of soil chemicals, and apply computer models for analyzing transport. What activity of this list is false?

***Exercise 11. Put adjectives below in a correct order according to the rule, described in the dialogue following it*:**

Weakening egg awful shells; organic unknown chemical; health difficult consequences; soil Italian contamination; heavy black metals.

A: What is the order of *adjectives of quality*, referring to one noun?

B: Several variations are possible but a fairly usual order is adjectives of size, general description, age, shape, color, material, origin, and purpose. Examples: a long sharp knife, a round white cup, an elegant French clock.

A: Can you give an example of compound nouns formation?

B: Remember that gerunds are used to form *compound nouns* (gerund goes as the adjective of purpose). Examples: riding boots, walking stick.

A: Thank you. And what is the order of *adjectives of personality / emotion*?

B: These adjectives come after adjectives of physical description, including "dark", "fair", and "pale". Examples: a small suspicious official, a pale transparent mixture.

A: Adjectives "fine", "nice", "beautiful", "lovely" are used very often. Is there any particular order?

B: They are followed with adjectives of size, shape and temperature to express approval of the size. If we say "a beautiful big room", "a lovely warm house", "a fine clean lab", we imply that we like big room, warm house and clean lab.

A: But in scientific text we can often see *several nouns* following one another. What is a proper way of translation?

B: Translate several nouns following one another as adjectives characterizing the last noun. And start translating from the end. Example: university building, carbon dioxide, iron ore.

Exercise 12. Speak on the topic "Solution for Soil Contamination".

ADDITIONAL TEXTS
FOR READING, TRANSLATING AND DISCUSSING

INDUSTRY, BUILDING WORKS AND POLLUTION

> "Pollution is nothing but the resources we are not harvesting. We allow them to disperse because we've been ignorant of their value." − R. B. Fuller

Many industries are responsible for discharging waste into water supplies and into the air. A less obvious hazard is the pollution of the ground beneath their structures and storage areas. When factories are decommissioned from use there is often a lengthy and expensive clean-up needed before the land can be re-used.

In the UK and in many industrial nations new land for building homes and schools is hard to find. In Britain every major urban area is surrounded by a "green belt" of agricultural land which is supposed to be safe from most kinds of development.

This means that "brownfield" sites are now the best choice for most new building developments. Brownfield sites are land which has previously been used for heavy industry or other buildings. What causes industrial land pollution? Three kinds of industrial pollution cause affecting urban land. The contaminants found on urban brownfield sites are broadly of three kinds: construction debris; petrochemical contamination from transport and fuels; and heavy metals and chemicals. Construction and demolition debris has to be sorted and removed. Currently, much of it ends up in landfill sites where it may pose problems. There are many new initiatives to increase the recycling of demolition debris and so reduce the pressure on landfill sites. Standards are rising as more brownfield sites are chosen for redevelopment.

INDUSTRIAL LAND REMEDIATION

There have been cases where land redeveloped for housing has been found later to be heavily polluted with toxic wastes left behind from industry. In some cases families have had to contend with pollutants in the very ground that their homes and gardens were built upon and where their children play. Checks have to be made for heavy metal and petrochemical contamination before land can safely be re-used. In Britain, the Environment Act of 1995 targeted the legacy of land contamination from the Industrial Revolution. It allows the identification and remediation of land which poses

“unacceptable risks” to human health and/or the wider environment. Many other post-industrial nations will have similar initiatives in place for undoing soil pollution. There are limits to this “remediation”, however. Land is only brought up to a standard acceptable for its intended use. This means there is still plenty of industrial waste buried under the concrete of parking lots and the like. This might not matter in some cases but some such pollutants may have unlooked for long-term effects. Real pollution solutions may involve far tighter regulations and more protection against pollution happening in the first place.

Industrial pollution causes in developing nations. Many developing nations are not so well protected and uncontrolled industrial pollution is still going on. This lack of regulation is often exploited by industrialized nations which simply export their problem pollutants to third world countries. This means that many developing nations have a double burden of pollutants which affect vulnerable people who have little in the way of health care or workers’ rights to protect them.

TESTING FOR POLLUTANTS

Testing for pollutants is becoming more sophisticated and some equipment is portable. Assessments can be done for land pollution at multiple points so that “hot spots” are found quickly, and results are available immediately. This speeds up decisions about how useful land is for the people intending to use it. If soil pollution is revealed, remediation can sometimes be undertaken. The most popular instruments are X-Ray Fluorescence (XRF) instruments for metals contamination detection and PID gas detectors for hydrocarbon pollution.

Mines and factories as pollution sources. Mine works can act as a source of land pollution. Heavy metals such as cadmium and lead may be deposited locally. Other metals such as copper may be deposited in unsafe amounts. Some of these toxic metals accumulate over time. Some deposits may take thousands of years to disperse naturally to safe levels. Metal recycling facilities can also account for some land pollution incidents. Many factories still release pollutants into air and water supplies; some of these pollutants can also affect the land.

Agricultural pollution from farms and farm machinery. Farms can cause land pollution by allowing manure to accumulate and leach into nearby ground. (Farming is an industry, so this is a type of industrial land pollution.) Chemicals such as those used in sheep dipping have also caused serious incidents on farms and diesel oil spills are a relatively common

danger. Modern farming also creates quite a lot of waste such as plastic wrapping for silage, used pesticide containers and old tires and batteries and machinery. All these potential sources of pollution have to be effectively recycled. Time was, a lot of these pollutants were burned or buried. In the UK new regulations mean that all these wastes have to be disposed of in a controlled and regulated way. One big cause of land pollution is agricultural run-off from fertilizers. They can cause havoc in the eco-system and affect wildlife profoundly, ultimately contaminating rivers and lakes. Herbicides and pesticides can also persist in soils and accumulate in the bodies of living organisms – including you and me. Some pesticides may contain POPs or Persistent Organic Pollutants. The problem with these, as the name suggests, is that they really do persist, turning up in human and animal tissue and breast milk.

HUMAN SEWAGE IS SOMETIMES A LAND POLLUTANT

Human sewage is not generally a problem in developed nations − except during emergencies, such as when Hurricane Katrina caused sudden flooding in New Orleans. Poorly maintained sewage pipes, informal settlements such as shanty towns, and the large amounts of refuse due to overcrowding and poverty can all cause land pollution in many developing countries. Removing wastes to proper disposal points costs time and money. Illegal dumping of solid wastes accounts for a lot of pollution in some countries. And some countries still do not have proper waste management systems in place at all. Until the 1930s it was common for people here in Britain to bury most of their rubbish in the back garden.

Fly tipping and other ways of littering. Littering and fly-tipping by informal traders and individuals can be a source of pollution. Even big companies can be responsible for quite a lot of unintentional rubbish. Near local superstores the hedges are littered with the tattered remains of old plastic bags. These can be a threat to wildlife, as well as looking unsightly. Fast-food outlets are notorious for overflowing refuse bins and street litter which can attract rats. Consumer products such as computers and old fridges contain hazardous components which need careful, controlled disposal. So when traders and individuals solve their waste problem, the wider environment is at risk. Asbestos, household waste and vehicle parts are common waste materials found at pollution incidents, according to the UK Environment Agency. Asbestos has been banned for years but is still being found from the time when its use was widespread in housing and brake-linings.

What are the effects of land pollution? Land pollution can have many effects upon us and upon animals and wildlife. Also many land pollutants

can wash into water sources such as rivers and reservoirs. Here are some of the main health concerns for humans. Skin problems, respiratory problems, birth defects and cancers can all be caused by some of the most serious pollutants. Toxic pollutants can get into our bodies directly through skin contact or by breathing in particles or dust. Some pollutants can get into our systems indirectly from eating vegetables grown in contaminated soil.

What can we do to prevent land pollution? Which cause of land pollution is the most urgent depends to some extent upon who you are and where you are. We can make sure that our personal litter is disposed of properly. Here are a few ideas for things we can do to prevent or reduce land pollution. We can make sure that domestic items which are no longer needed are reused if possible and if they are beyond use they are recycled. Many modern consumer items such as batteries need proper disposal; chucking them into the rubbish bin is no longer enough. We can support companies which have a strong ethical and well thought out approach to recycling and waste disposal. We can buy our food from local, organic sources where possible and so reduce the use of pesticides and pollution from transport sources. We can make sure that all the packaging we receive when buying new goods gets properly recycled. Most municipal councils run recycling facilities these days. There are charities which will recycle or reuse many domestic goods in urban areas. Some will even collect heavy items. In the UK Freecycle offers a service where people can give or take freely offered goods. However, there are many companies now which specialize in testing and cleansing polluted post-industrial land. Most developed nations and many developing nations now have organizations dedicated to informing the public about pollution issues, advising industry and businesses and analyzing risks and effects of contaminants.

INDUSTRIAL POLLUTION BRINGS SUFFERING TO 125 MILLION PEOPLE: REPORT

One hundred and twenty-five million people around the world suffer from serious health problems that stem from industrial pollution − a public health crisis on par with malaria or tuberculosis (TB). The report documents sickness in 49 low and middle income countries with large industrial sectors, including toxin heavy mining sites, tanneries, chemical factories and toxic waste processing sites, and traces the most common industrial pollutants – lead, mercury, chromium, radionuclides and pesticides – in the air, water and soil of the, so called, developing countries. Those most often sickened by the pollution are children. A leading factor in the rise of dan-

gerous and unregulated toxic sites in these countries is industrial globalization, especially international mining and resource extraction, and global consumer demand. Much of this industrial activity is to serve our needs in the developed world.

INDUSTRY AS A SOCIAL PARTNER

In recent years, U.S. industries and citizens have recognized their joint responsibility to ensure that chemical products are manufactured with a net benefit and minimum hazard to society. The EPA has initiated a "Design for Environment" program that is having an impact on the ways chemical process does business. For example, over the past decade, the chemical industry has begun to develop new synthesis methods, based on using safe starting materials that replace toxic or environmentally unsafe substances. This new "green chemistry" focuses on preventing environmental pollution directly at the point of manufacturing. In this approach, the chemical industry is trying to work as a social partner to sustain development and international trade without damaging the environment.

New "benign by design" chemical processes use more environmentally benign reactants and create waste product that do less damage to air and water. For example, a process has been developed using D-glucose, found in the ordinary table sugar, to replace benzene, a known carcinogen. The D-glucose serves as the chemical feedstock to make reactants that eventually produce nylon and various medicines. Also, non-toxic food dyes have been demonstrated in some processes to be effective substitutes for catalysts composed of toxic metals such as lead, chromium, or cadmium.

Phosgene, a toxic gas, can be replaced by carbon dioxide in the manufacture of isocyanates. Isocyanates are substances used to make polyurethanes, materials used widely in the manufacture of seat cushions, insulations, and contact lenses. In addition, "green chemistry" seeks ways to synthesize industrial chemicals in water solutions rather than in toxic solvents, and to use materials that can be recycled and reused to reduce waste disposal problems significantly. To succeed commercially, these newly developed processes must also be cost effective.

The chemical industry also has responsibility to make products in ways that are as hazard-free as possible, in workplaces that are as safe as possible. Industry is obliged to deal honestly with the public to ensure that risks and benefits of chemical operations are clearly known. Chemical companies also need to assure consumers that the products are safe when used as intended by the manufacturer.

Chemical industries must comply with certain laws and regulations, as well as with voluntary standards met by manufacturers. Often, compliance with voluntary requirements is monitored by independent, outside organizations. An international initiative, ISO 9000, calling for voluntary quality management systems, has been developed by the International Organization for Standardization (ISO) in Geneva, Switzerland, in conjunction with representatives from the USA and 73 other countries.

In addition, there is a worldwide movement to improve environmental quality. The governments of various nations around the world have passed laws to regulate environmental pollution, although the laws are not consistent from country to country. A program known as ISO 14000 has been developing an international series of standards to help manufactures and organizations consider the impact of their operations, products, and services on the environment. Work on ISO14000 standards is being carried out by representatives from more than 110 countries. The goal is to develop one set of internationally accepted environmental management system standards rather than many, sometimes conflicting, national standards.

No activity of the chemical industry or the government can completely eliminate the risks involved in manufacturing chemical substances, any more than the risks of travelling in a car can completely be eliminated. Knowing the risks, continuing to explore them, and dealing with them prudently are essential.

These concerns are not the sole responsibility of the chemical industry. As users of the industry's products, we share this responsibility.

THEY DISCUSS POLLUTION PROBLEMSS ALL OVER THE WORLD

Pollution is quickly becoming a devastating phenomenon and normally has diverse effects on people, the environment and all creatures, both in the short and long run.

Look at some of the pollution catastrophes that continue to wreak havoc in several countries around the world. Much of the pollution mayhem is attributed to various man-made causes, including, but not limited to, issues ranging from system failures of extraction companies, accidents caused by natural factors and poor industrial disposal mechanisms.

Poor industrial disposal features prominently; in most cases industries discharge their effluents into water bodies, such as wetlands, rivers and lakes, as well as into the air. A recent case in point are the sugar factories in Jinja and Lugazi, which are allegedly discharging effluent, especially from

the molasses, and the burning of bagasse, which are polluting the water and air, respectively.

This has not gone down well with the residents in those areas as they are now developing health complications. Effluents from most industries in urban centers surrounding Lake Victoria end up in this water body, and this explains the greenish mass that forms a floating mat in some areas of the lake.

The world over, it is common practice by industries to use the cheapest ways of disposal and waste management mechanisms as a way of minimizing on operational costs. This is rather calamitous as it compromises on the deliberate efforts on environmental protection and is a precursor to serious environmental disasters.

The oil well blowout in the Gulf of Mexico in 2010, in which an oil rig off the southern coast of USA developed a leak, dumping millions of gallons of crude oil into the sea, was one such catastrophe.

By the time it was finally sealed 12 weeks later, the nation had experienced the world's worst oil spill, where 205 million gallons (4.9 million barrels) of oil had spewed from the leaking well, fouling over 600 miles of beaches and wetlands spread across five states, and today, the gulf is still struggling to fix the adverse effects of the spillage.

The cost of cleaning up pollution disasters is immense. For example, the Fukushima nuclear power plant in Japan that exploded as a result of an earthquake in 2011 and belched out radioactive materials, is to cost the Japanese government at least one trillion yen ($13 billion) to clean up vast areas contaminated by radiation.

Japan faces the prospect of removing and disposing 29 million cubic metres of soil from a sprawling area in Fukushima, located 240 kilometres northeast of Tokyo, and four nearby prefectures. The situation would have been worse if Japan lacked a good emergency disaster management strategy and institutions in place.

Therefore, in the emerging oil and gas sector in Uganda, serious intervention measures ought to be designed to prepare for pollution that may arise from the sector, especially addressing the laxity in implementing pollution laws, which leaves the country more vulnerable to pollution.

In the recently-passed Petroleum Exploration, Development and Production Bill 2012 for Uganda, one would argue that the lawmakers played a fantastic role in legislating in the oil sector, requiring that those who pollute must clean up their mess. But the emerging limitations among the responsible government regulators to command the necessary standards of safety are hampered by lack of authority, resources and technical expertise related to oil developments.

Increasingly, neither the regulations nor the regulators are asking the tough questions or demanding the demonstration of preparedness by the actors in the sector to prove that they would ably avoid the disasters. These would include the adoption of the "polluter pays principle", requiring operators to prevent, or in the case of an accident, remedy the damage to water, soil and the environment in general.

As the need to develop the pollution regulatory framework becomes eminent, safety via the approval of facility-specific waste pollution emergency plans has to be fully catered for in a seemingly fragile economy dogged by weak institutions.

Nevertheless, deliberate efforts to address messes from sabotage and natural causes should not be overlooked. Before an installation is approved, it should be necessary for the operator to produce a document detailing how an effective safety management system and emergency disaster strategies have been put in place.

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