

**MINISTRY OF HEALTH OF UKRAINE**  
**O.O. BOGOMOLETS NATIONAL MEDICAL UNIVERSITY**

**“Approved”**

at the methodological conference of hygiene  
and ecology department

**Head of the department**

correspondent member of NAMS of Ukraine,  
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**GUIDELINES**  
**FOR STUDENTS**

<i>Subject</i>	Hygiene and ecology
<i>Module № 1</i>	Assessment of the environment and its impact on the population health
<i>Submodule № 6</i>	Radiation hygiene
<i>Topic of the lesson</i>	Hygienic assessment of radiation protection of personnel and patients under usage of radionuclides and other sources of ionizing radiation in patient care institutions.
<i>Course</i>	6
<i>Faculty</i>	medical
<i>Author</i>	prof. Pelio I.M., asst. prof. Antonenko A.M.

## **1. Learning objective**

1.1. Extend, methodize and strengthen knowledge on radiation hazard for personnel and patients of patient care institutions during usage of radioactive nuclides and other sources of ionizing radiations in diagnostic and treatment purposes, on principles and ways of radiation protection.

1.2. Master methods and ways of radiation control of labour conditions of personnel and protection of patients in X-ray and radiological departments of hospitals.

1.3. Consolidate, extend and methodize knowledge about radiation hazard of population, and the personnel at work with radioactive nuclides and other sources of ionizing radiation.

1.4. Master methods and means of measurement of radiation levels and concentration of radioactive nuclides in the air, water, food substances, of radioactive pollution of the work surfaces, individual doses of irradiation of those working with sources of ionizing radiation, to assess their results.

## **2. Basics**

2.1. You should know:

2.1.1. Qualitative and quantitative properties of ionizing radiation.

2.1.2. Sources of ionizing radiation, their occurrence in the environment.

2.1.3. Usage of radioactive nuclides and other sources of ionizing radiation in industry, medicine, scientific researches.

2.1.4. Biological effect of ionizing radiation and conditions it depends on.

2.1.5. Essence of radiation hazard at work with radioactive nuclides and other sources of ionizing radiation in different branches of industry.

2.1.6. Foundations of hygienic control of radiation safety and regulations of radiation safety and Primary sanitary regulations of work with active materials and other sources of ionizing radiation.

2.1.7. Classification of types and devices of radiation control, principles of work of those devices.

2.2. You should have the following skills:

2.2.1. To prepare of devices of radiation control for work, conduct measurements, read devices, assess results.

## **3. Self-training questions**

3.1. Radiation hygiene as a branch of hygienic science and sanitary practice, its objectives and problems.

3.2. Ionizing radiations used in industry, science, medicine, their sources (X-ray apparatuses, radioactive nuclides, charged particle accelerators, nuclear

reactors, enterprises on quarrying and enrichment of nuclear raw materials, on processing and entombment of radioactive waste).

3.3. Qualitative and quantitative properties of radioactive nuclides as sources of ionizing radiations (types of nuclear transformations and of radiations that accompany them), half-life period, activity,  $\gamma$ -equivalent, their units.

3.4. Qualitative and quantitative properties of ionizing radiation (energy, penetrant and ionizing power). Types of doses, their units. Dose rates.

3.5. Ionizing radiation as industrial hazard, conditions that determine radiation hazard at work with them (type and energy of radiation, quantity of absorbed dose, type of radiation effect, allocation of energy in the organism, radiosensitivity of the organism, and danger of radioactive nuclides).

3.6. Main types of radiation damage of the organism (deterministic, stochastic) and conditions of their origin.

3.7. Acute and chronic radiation sickness, conditions of its origin, phases of clinical course, basic symptomatology.

3.8. Long-term effects of radiation damage, local lesions (carcinogenic, teratogenic, embryotoxic effects, radioactive burn etc.)

3.9. Regulations of radiation safety and Primary sanitary regulations of work with active materials and other sources of ionizing radiation, principles of hygienic control.

3.10. Methods and means of radiation and medical control at work with sources of ionizing radiation.

3.11. Ionizing radiation as occupational hazard for personnel of hospitals.

3.12. Ionizing radiation as risk factor for patients of hospitals during radiology and nuclear diagnostic and treatment procedures.

3.13. Structure of radiological department of hospital. Peculiarities of radiological hazard and radiation protection in each organization department (bare, sealed sources, long-focus therapy).

3.14. Characteristics of radiological hazard in X-ray diagnostic room and conditions it depends on.

3.15. Regulations of radiological hazard and benefits for personnel and patients of patient care institutions (NRSU-97, MSRU-01, other legislative documents).

3.16. Ways of decreasing of radiation exposure of personnel and patients of patient care institutions. Sanitary and technical equipment of X-ray and radiological departments.

3.17. Methods of collection and neutralization of radioactive waste during work with bare sources of ionizing radiation.

3.18. Methods and ways of sanitary control and survey during work with sources of ionizing radiation in patient care institutions.

#### 4. Self-training assignments

4.1. Chart the summary table of characteristics of ionizing radiations with characteristic of radiation danger at work with them.

Type of ionizing radiation	Source of radiation	Ways of use	Characteristics of radiation			Ionizing power	Characteristic of radiation danger
			Energy	Penetrant power			
				in the air	in biological tissue		

4.2. Enumerate conditions, which the biological effect of ionizing radiation depends on, and peculiar properties of radiation danger at quarrying, enrichment and use of sources of ionizing radiation in nuclear-power engineering, science, medicine, military science.

4.3. Enumerate administrative and technical, hygienic methods and ways of protection from ionizing radiation and methods of protection based on physical laws of weakening of radiation, their legislative solutions.

**5. Structure and content of the lesson** (duration of the lesson 160 min + 10 min break)

5.1. Preamble – 5-10 min.

5.2. Test control for assessment of students' knowledge datum level – 10-15 min

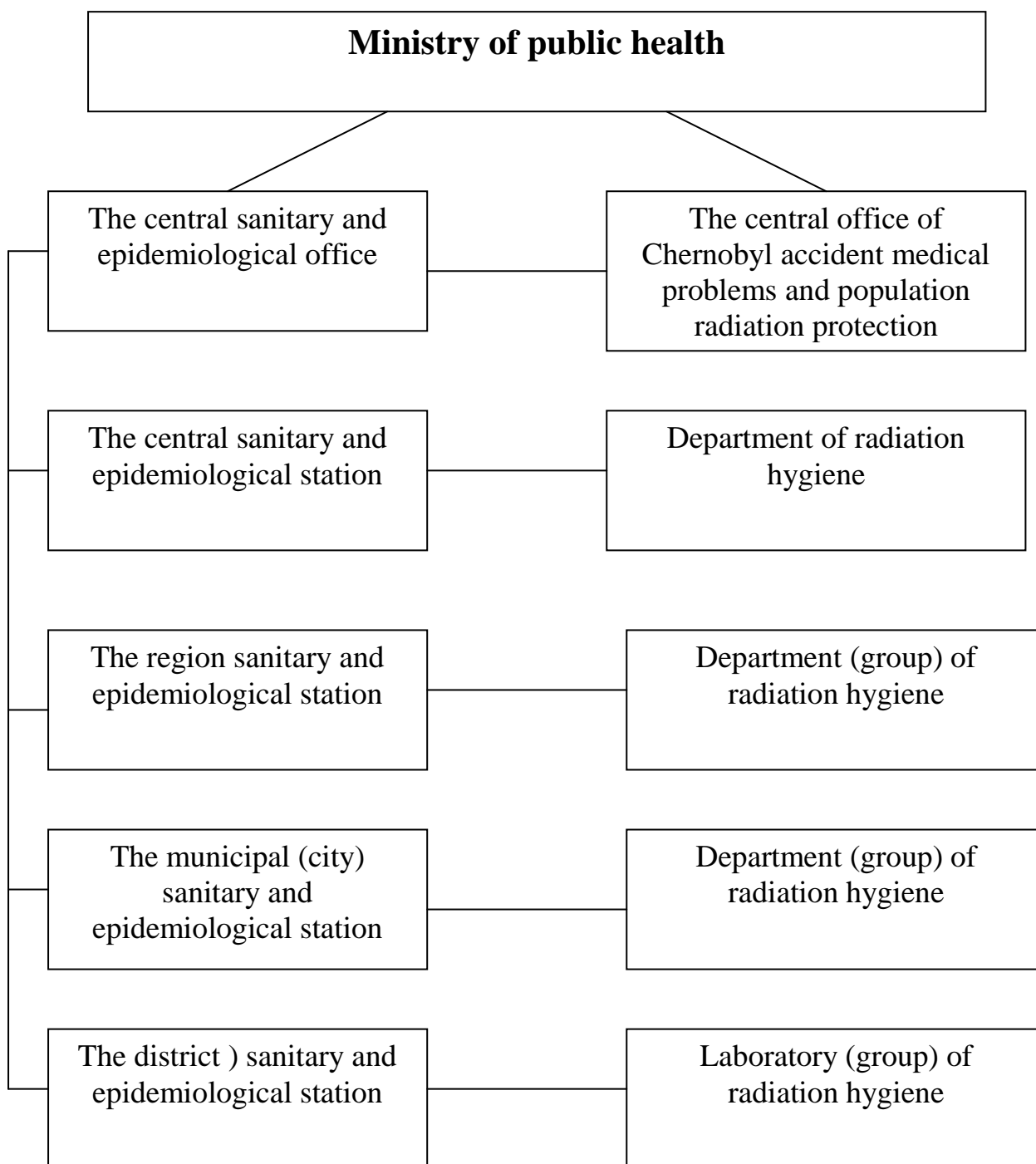
5.3. Theoretical training – 30-40 min.

5.4. Typical situational tasks “Krok-2” solution – 30-40 min.

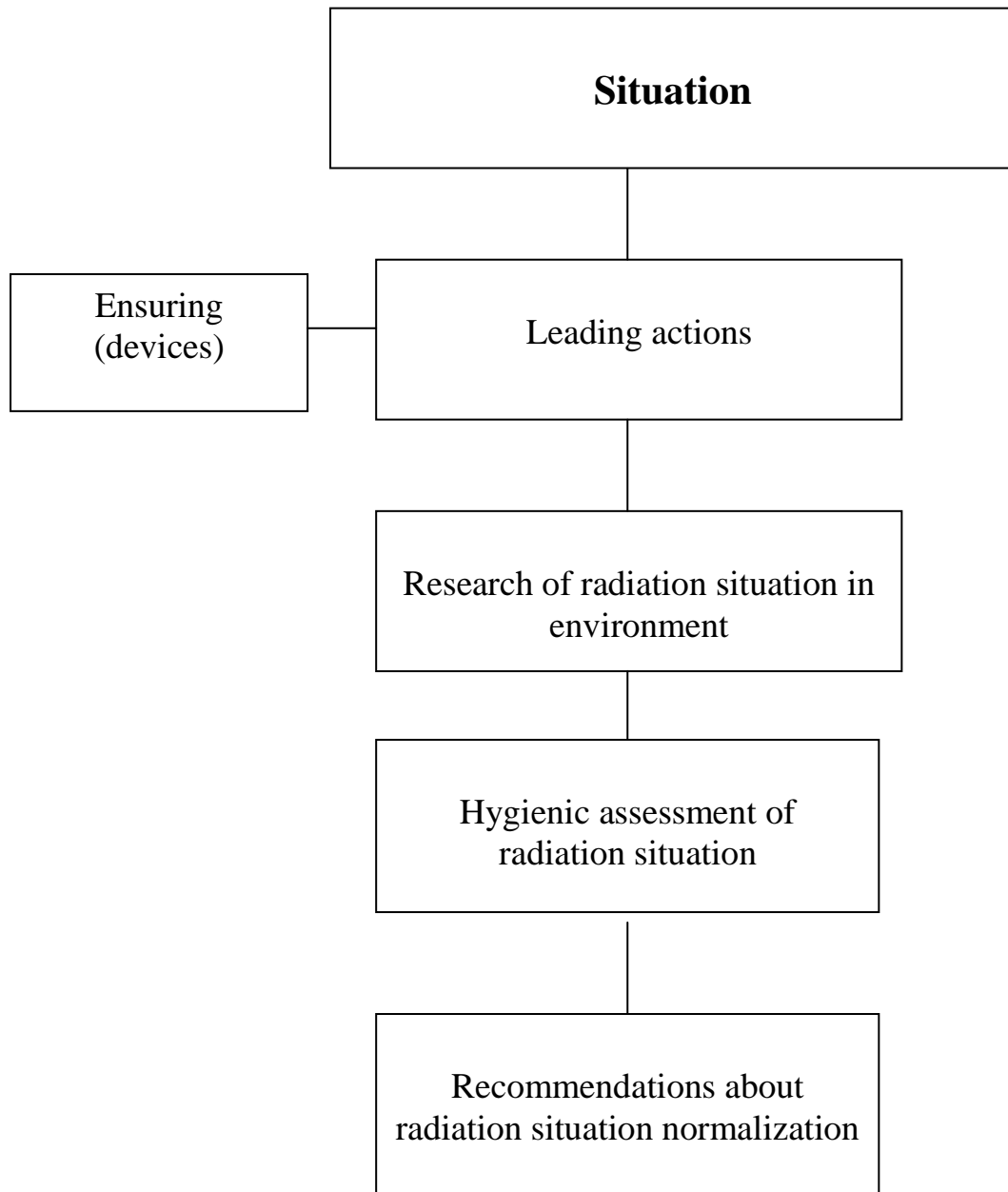
5.5. State exams situational tasks solution – 30-40 min.

5.6. Test control for assessment of students' knowledge final level – 10-15 min.

**Organization of Sanitary and epidemiological service work from  
radiation hygiene**  
**(Departments and offices of public health Ministry which carry out control of  
radiation safety)**



## Organization of Sanitary and epidemiological service work from radiation hygiene



## **Radiation investigation methods**

Absolute method	Relative method
Experimental determination or calculation of correction factors	Preparing and calculation of activity standards
Determination of calculation speed of investigated device	Determination of calculation effectiveness
Calculation of specific activity with consideration of correction factors	Measuring and calculation of specific activity

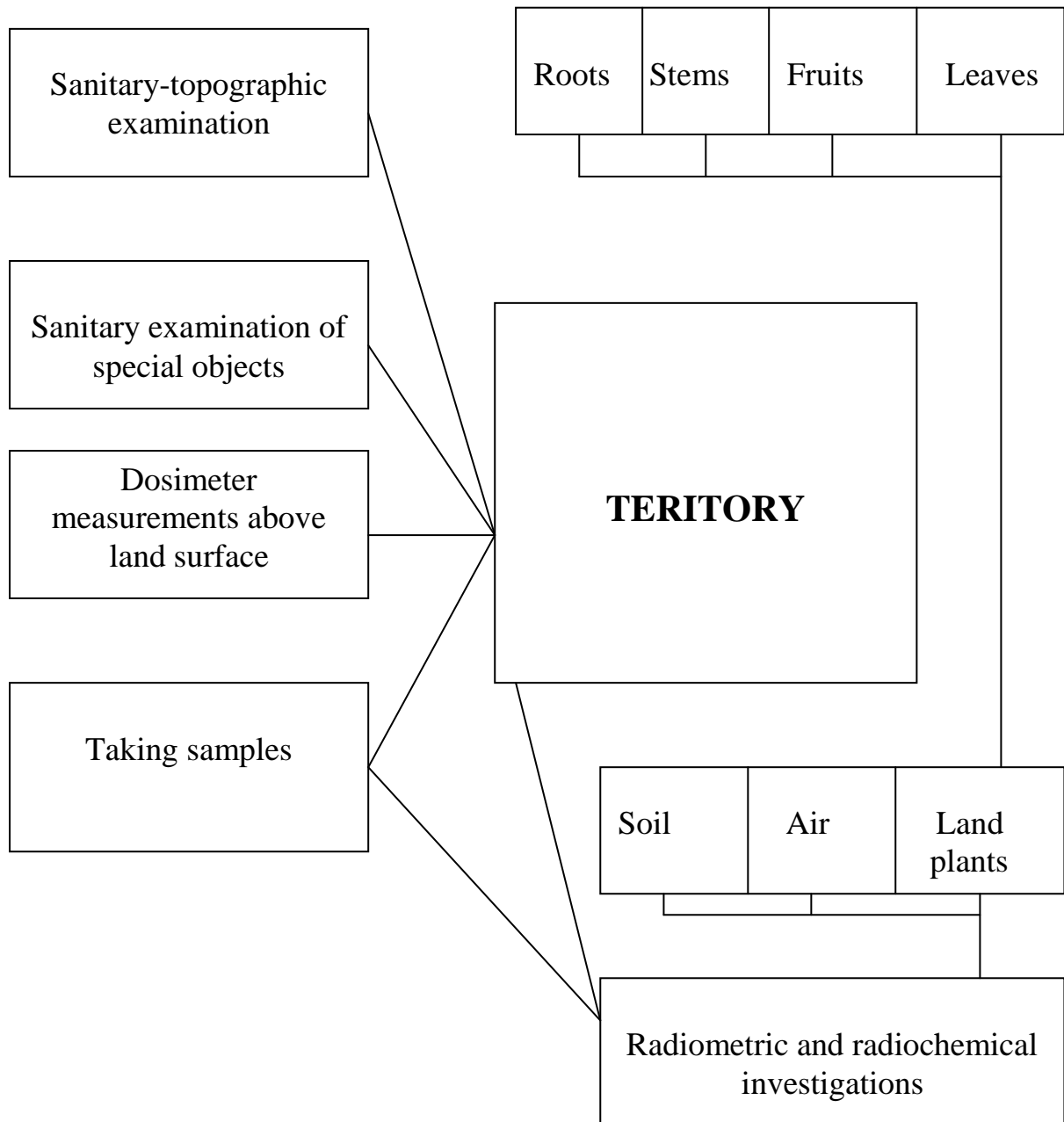
## **Methods of irradiation registration**

1. ionization
2. scintillation

## **Product which must be obligatory controlled for radiation**

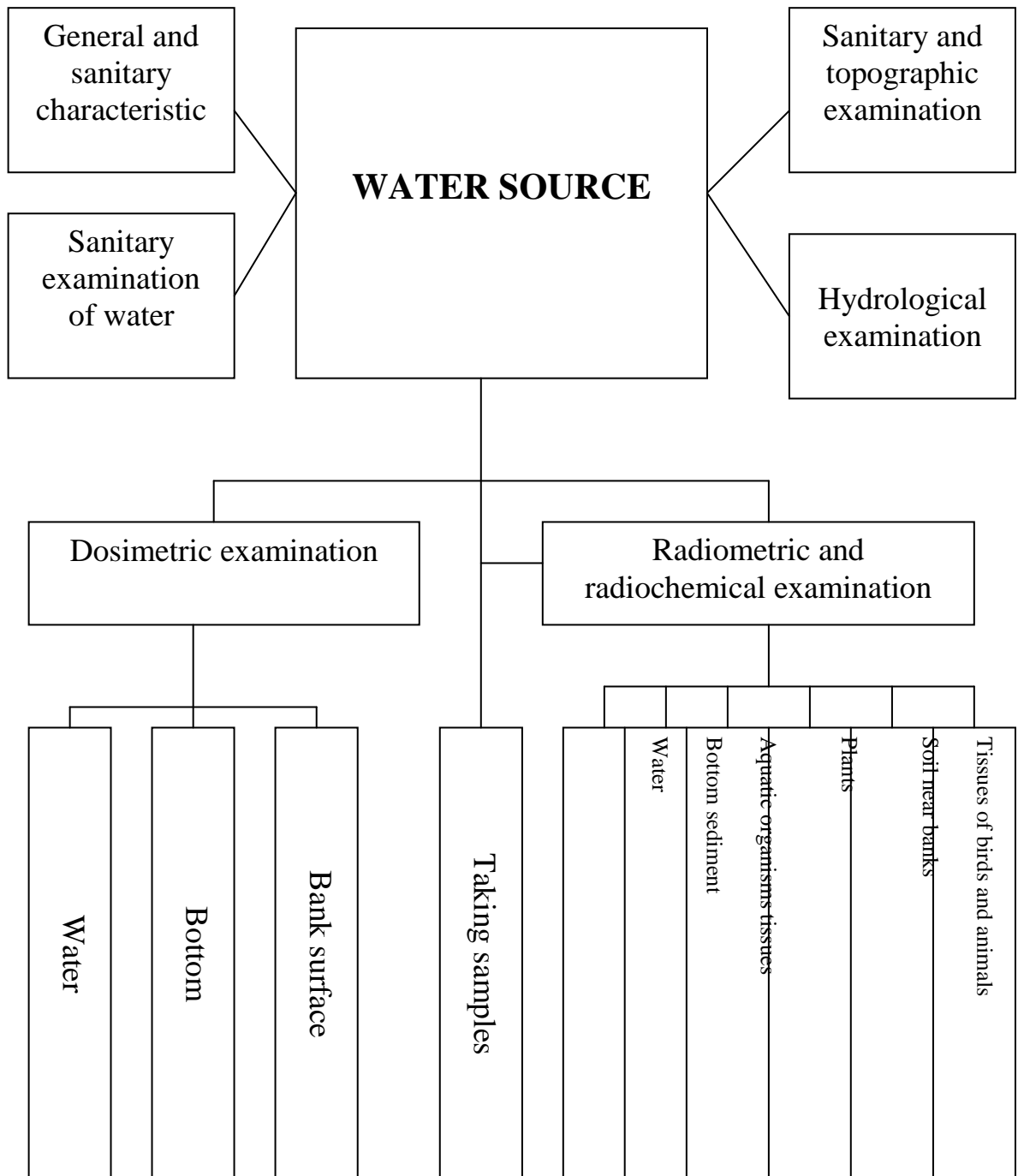
1. building materials
2. food stuffs and water and all material which can contact with them in process of production
3. oil, coal
4. materials which have material valuability
5. fertilizers
6. loamy, glass and delft ware
7. mineral paints
8. paper production
9. wooden materials

## Scheme of territory examination

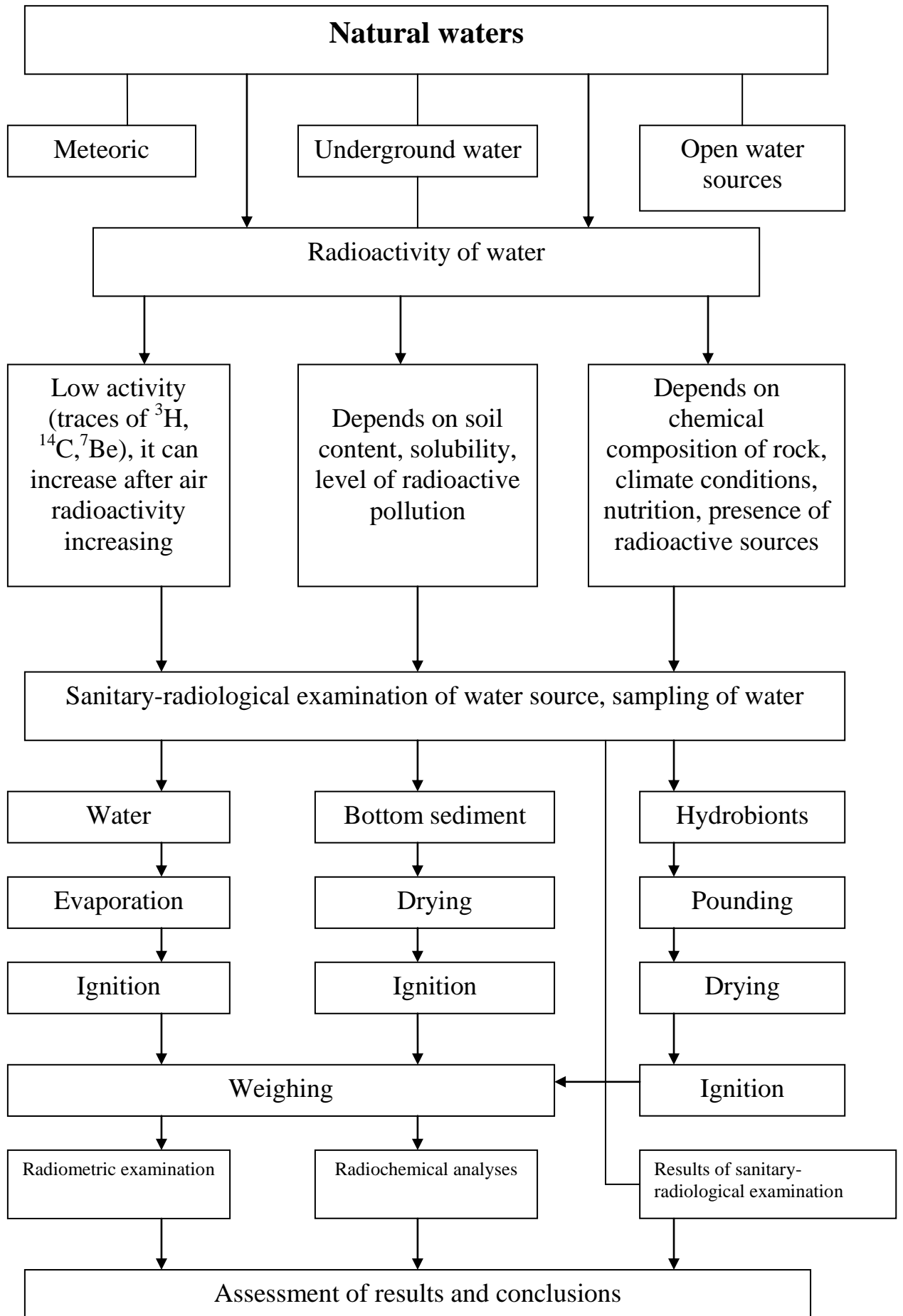




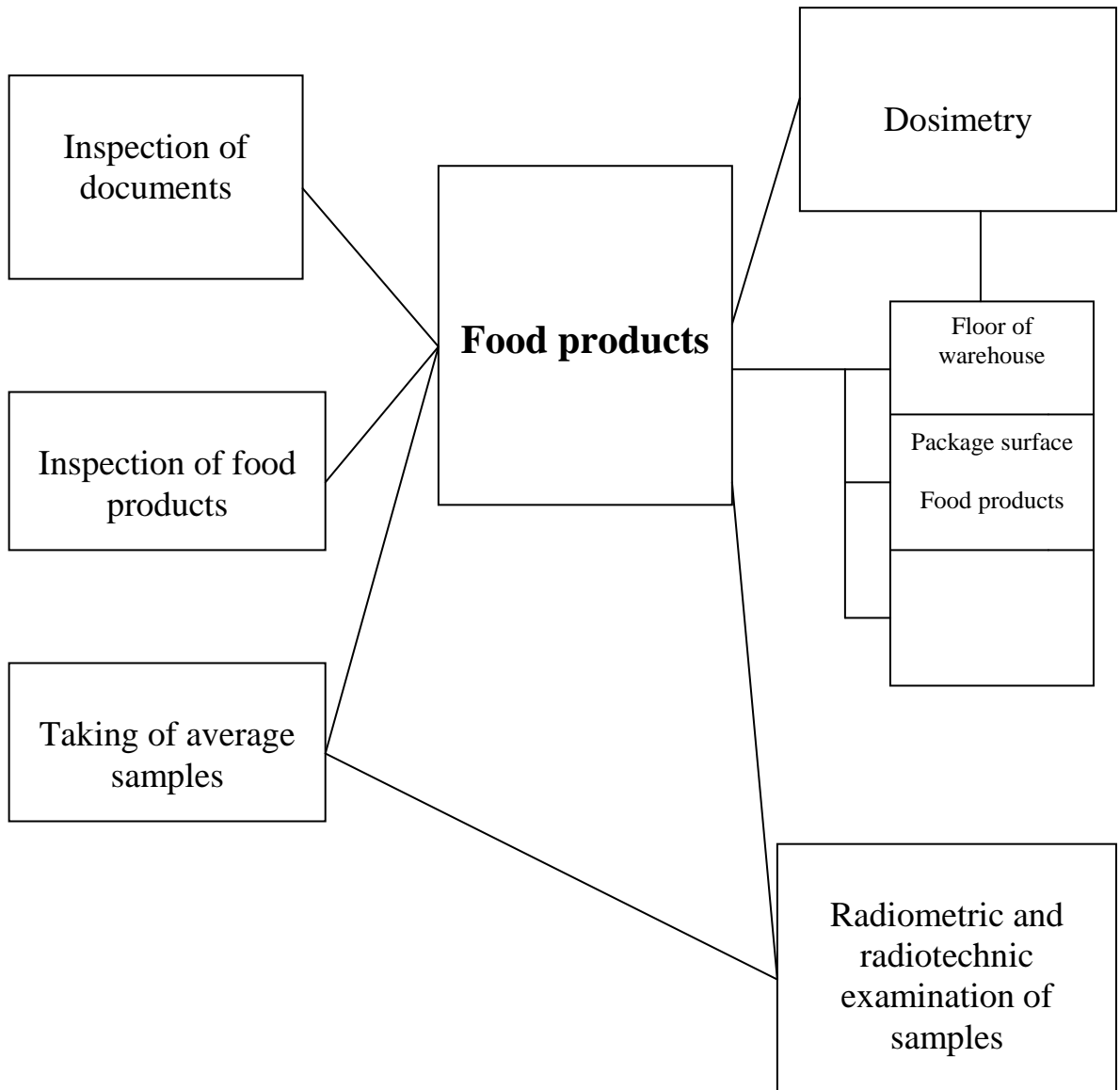
## Scheme of water source examination



## Methods of radioactive water examination



## Scheme of food products examination



## Sampling

**Meat** – samples are taking from 3-5 carcasses of animals or birds and unite in one sample. Bones (fungous part) must be 1/5 of all sample and they are taking from the same carcasses like meat.

**Fish** – samples unite according type (freshwater or sea) and character of processing (fresh, chilled salted). Fish is taking whole (with mass less than 0,5 kg) or separate parts (head with part of carcass or part of carcass).

**Milk** – samples are taking from general tankage and frosted.

**Bread** – mass of sample must be 1 kg of white and 1 kg of wheat bread.

**Water** – water of open is sampling two times a year in spring and at the end of summer on distance not less than 5 meters from bank, on the depth no less than 1 meter. Water from central water supplying system is taking on the same way like for general sanitary examination.

### Situational tasks

1. Examination of radiation safety of shop floors and joint premises was conducted in therapeutic department #2 of the central hospital. X-ray room is situated on second floor; joint premises of it are hall and corridor; checkroom occupied by X-ray room; there are offices for temporary personnel and students stay on third floor over it. Industrial premises correspond to Sanitary norms and rules – X-ray departments.

Results of dosimeter control:

- absorbed in air dose capacity on X-ray doctor's working place – 30-40 mR/h;
- absorbed in air dose capacity on X-ray laboratory assistant's working place – 18-16 mR/h;
- absorbed in air dose capacity in joint premises - 18-16 mR/h;

Assess level of radiation safety:

1. Name and explain risk factor and its mechanism of action.
2. Assess radiation safety in object.
3. Give a prognosis of possible and real result of risk factor influence.
4. Name and substantiate preventive measures.
5. Method of absorbed in air dose capacity determination and devices for it.

2. Conditions of nutrition in city N., which territory was polluted in result of Chernobyl accident, were determined. This territory pertained to zone of intensified radiation control. Level of radioactive pollution by cesium-137 and strontium-90 of food of native origin is

#	Food products	Cesium-137 Bk/kg	Strontium-90 Bk/kg
1	Bread	18-20	3-5
2	Potatoes	45-55	15-20
3	Vegetables	30-40	15-20
4	Fruits	50-60	7-10

5	Meat	150-200	15-20
6	Fish	140-150	30-35
7	Milk	80-100	15-20
8	Growing wild berries and mushrooms	300-400	30-40
9	Medicinal herbs	400-750	120-150

1. Name and explain risk factor and its mechanism of action.
2. Give a prognosis of possible and real result of risk factor influence.
3. Name and substantiate preventive measures.
4. Name criteria of level of radioactive pollution assessment
5. Method of determination of level of cesium and strontium in food products by “Adani” radiometer

## 9. Literature

### 6.1. Principal:

6.1.1. Загальна гігієна. Пропедевтика гігієни. /Є.Г.Гончарук, Ю.І.Кундієв, В.Г.Бардов та ін. / За ред. Є.Г.Гончарука. – К.: Вища школа, 1995. – С.254-270.

6.1.2. Общая гигиена. Пропедевтика гигиены. /Е.И.Гончарук, Ю.И.Кундиев, В.Г.Бардов и др. – К.: Вища школа, 2000. – С.307-333.

6.1.3. Ильин Л.А., Кириллов В.Ф., Коренков И.П. Радиационная гигиена. – М., Медицина, 1999. – С. 27-121.

6.1.4. Кириллов В.Ф., Архангельский В.И., Коренков И.П. Руководство к практическим занятиям по радиационной гигиене. – М., 2001. – С. 8-100.

6.1.5. Даценко І.І., Габович Р.Д. Профілактична медицина. Загальна гігієна з основами екології. – 2 видання: К.: Здоров'я, 2004, - С. 639-650.

6.1.6. Загальна гігієна. Посібник для практичних занять. І.І.Даценко, О.Б.Денисюк, С.Л.Долошицький та ін. / За ред. І.І.Даценко. – 2 видання: Львів: Світ, 2001. – С.394-421.

6.1.7. Норми радіаційної безпеки України (НРБУ-97). – Наказ МОЗ України № 62 від 01.12.1997 р. – 121 с.

6.1.8. Основні санітарні правила забезпечення радіаційної безпеки України (ОСПРБУ-05) – Наказ МОЗ України № 54 від, 02.02.2005 р. – 141 с.

6.1.9. Lecture materials.

### 6.2. Additional:

6.2.1. Нікберг І.І. Радіаційна гігієна. – К.: Здоров'я, 1999. - С.6-11, 116-124.

6.2.2. Пивоваров Ю.П., Гоева О.З., Величко А.А. Руководство к лабораторнім заняттям по гигиене. – М., Медицина, 1983. – С. 114-135.

6.2.3. Гігієна та екологія людини: навчальний посібник до практичних занять. /За ред. В.Я. Уманського. – Донецьк: „НОРД Комп'ютер”, 2004, - С.207-214.

## ***NEW REFERENCES***

1. Hygiene and ecology: textbook for students of higher medical educational establishments / under the editorship of corresponding member of NAMS of Ukraine, prof. Bardov V.G. – Vinnytsia: Nova Knyha, 2009. – 688 p.
2. Hygiene and ecology / V.A. Korobchanskiy, M.P. Vorontsov, A.A. Musulbas. – Kharkov, 2006. – 207 p.
3. Medicine of emergency situations: textbook for students of higher medical institutions / V.V. Chaplyk, P.V. Oliynyk, S.T. Omelchuk, V.V. Humenyuk. – Vinnytsia: Nova Knyha, 2012. – 344 p.
4. General nutrition: Study guide for the 4<sup>th</sup> accreditation level Medical School Students / edited by S.T. Omelchuk, O.V. Kuzminska. – Kyiv, 2016. – 146 p.
5. Гигиена и экология: учебник для студентов высших медицинских учебных заведений. – Винница: НОВА КНИГА, 2008ю – 720 с.

### **9. Equipment required for the lesson**

1. Models of devices for radiation control:
  - Roentgenometers and microroentgenometers for measurement of absorbed in the air dose rates (exposure doses);
  - Personnel dosimeters;
  - Portable activity meters for measurement of radioactive pollution of the surfaces;
  - Stationary and portable activity meters for measurement of the concentrations of radioactive nuclides in objects of the environment.
2. Extracts from instructions for some microroentgenometers and personnel dosimeters.
3. Tasks for students on measurement of absorbed in the air dose rates and individual doses of irradiation.
4. Situational tasks.
5. Tests.