

Curriculum is based on the educational program «Pharmaceutical Botany», approved 15.11.2023 registration # УД-091-036/2324/уч.; on the educational plan in the speciality 7-07-0912-01 «Pharmacy», approved 17.05.2022, registration # 7-07-0912-01/2324/mf.

COMPILERS:

N.S.Gurina, Dean of the Pharmaceutical Faculty of the educational institution «Belarusian State Medical University», Sc.D, Professor;

O.A.Kuzniatsova, Associate Professor of the Department of Organization of Pharmacy of the educational institution «Belarusian State Medical University», Ph.D

RECOMMENDED FOR APPROVAL:

Department of Organization of Pharmacy of the educational institution «Belarusian State Medical University»
(protocol # 2 of 14.09.2023);

Scientific and Methodical Council of the educational institution «Belarusian State Medical University»
(protocol # 11 of 15.11.2023)

EXPLANATORY NOTE

«Pharmaceutical Botany» is an academic discipline of the Natural Science Module, which contains systematized scientific knowledge about the structure and functioning of plants on all levels of their organization, that are necessary in the professional activity of a pharmacist.

The aim of the discipline «Pharmaceutical Botany» is the formation of basic professional competence to solve problems in the use of medicinal plants and plant resources.

The objectives of the discipline «Pharmaceutical botany» are to form students scientific knowledge about the taxonomic diversity, external and internal structure, reproduction, relationships with the external environment, as well as the basics of cultivation and use of medicinal plants; abilities and skills necessary for pharmacognostic analysis.

The knowledge, skills, and abilities gained in the study of the academic discipline «Pharmaceutical Botany» are necessary for the successful study of the following academic disciplines: «Pharmacognosy», «Pharmaceutical Ecology», the module «Pharmaceutical Technology».

A student who has mastered the content of the study material of the educational discipline «Pharmaceutical botany» should have the following basic professional competence:

BPC. Apply knowledge of the basic physical, chemical and biological laws for quality control of medicines and medicinal plant raw materials.

As a result of studying the academic discipline «Pharmaceutical Botany» the student **should**

know:

the variety of morphological and anatomic structures of vegetative and generative organs of plants;

medical plants, that are studied in pharmacognosy;

signs of plants, that are used in diagnosing medical herbal materials;

basics of plants' taxonomy;

basics of phytosociology, geography and ecology of plants;

principles of rational exploitation of medical plants' populations;

be able to:

identify the systematics of a plant with the help of an identifier;

make a plan of plant vegetative and generative organs morphological description

perform basic histochemical reactions when analysing plant objects and interpret their analytical effect

diagnose the vegetative organs of plants using microscopic features;

analyze the anatomical structure of plant organs

explain the main diagnostic features of families and other plant taxones on the example of a herbarium specimen

apply reading and writing skills in Latin for names of plant taxones and herbarium plants

identify medicinal plants from external features in living and herbarised forms
 make a geobotanical description of phytocenosis;
 collect samples of medicinal plants and medicinal raw materials;

master:

skills of arrangement and analysis of temporary microscope slide of vegetative plants' organs;

skills of making morphological plants' description;

skills of cultivation medical plants.

Total number of hours for the study of the discipline is 230 academic hours. Classroom hours according to the types of studies: lectures - 24 hours (including 10 hours of supervised student independent work), laboratory classes - 102 hours, student independent work (self-study) - 104 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit (2 semester), and examination (3 semester).

Form of higher education – full-time.

ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	semester	Number of academic hours						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures (including supervised independent work)	supervised student independent work	laboratory studies		
7-07 0912-01 «Pharmacy»	2	120	63	12	5	51	57	credit
	3	110	63	12	5	51	47	examination
		230	126	24	10	102	104	

THEMATIC PLAN

Name of section (theme)	Number of class hours	
	lectures	laboratory
1. Systematics of lower and higher archegoniates	2	12
1.1. Introduction to pharmaceutical botany. Algae. Fungi	-	6
1.2. Higher archegonial plants	2	6
2. Morphology of plants	4	15
2.1. Morphology of plants vegetative organs	2	6
2.2. Morphology of plants generative organs	2	9
3. Flowering plants systematics	6	24
3.1. Systematic review of class Magnoliopsida	6	18
3.2. Systematic review of class Liliopsida	-	6
4. Cytology and histology of plants	6	30
4.1. The structure of plant cell, chemical substances and osmotic properties	2	12
4.2. Plant tissues	4	18
5. Anatomy of plants	6	21
5.1. Anatomy of stems and rhizoma	4	9
5.2. Anatomy of roots and leaves	2	6
5.3. Microscopic diagnostic signs of the vegetative organs of higher plants	-	6
Total hours	24	102

CONTENT OF THE EDUCATIONAL MATERIAL

1. Systematics of lower and higher archaegoniates

1.1. Introduction to pharmaceutical botany. Algae. Fungi

Pharmaceutical botany as a section of botany, containing systematized scientific knowledge necessary in the professional activities of the pharmacist. Integrative connections of pharmaceutical botany with natural and special disciplines.

Algae: general biological characteristics, classification, economic and medical significance. Characteristics of the most important taxones. Division Rhodophyta: cell structure, pigments, storage substances, peculiarities of reproduction, distribution, practical use, main representatives. Division Chlorophyta: general characteristics, cell structure, pigments, storage substances, importance of green algae. Division Phaeophyta: general characteristics, cell structure, pigments, storage substances, types of alternation of generations (isomorphic and heteromorphic), the most important representatives, use in medicine and pharmacy. Division Charophyta: general characteristic, peculiarities of body structure, representatives, importance.

Kindom Fungi: general biological characteristics. Types of mycelium. Haploid, dicarionic and diploid phases in the cycle of development. Types of fungi reproduction. Principles of classification of fungi. Characteristics of the main

divisions of fungi: Zygomycota, Ascomycota, Basidiomycota, Deuteromycota, the main representatives, importance and application in medicine. Division Lichenes: general biological characteristics, classification of life forms, reproduction. The role of lichens in nature and their use in medicine.

1.2. Higher archaeogonial plants

Higher plants: general biological characteristics, directions of evolution.

Division Bryophyta: general biological characteristics. Mosses as a special lineage of evolution of higher plants, peculiarities of development cycle, classification (classes of anthocerotids, liverworts and leafy mosses). Role in nature and application in medicine.

Division Lycopodiophyta: general biological characteristics, classification. Equispore and opposable lycopodium, developmental cycle, alternating generations and nuclear phase change, representatives, meaning and use in medicine.

Division Equisetophyta: general biological characteristics, cycle of development, classification, importance, representatives, use in medicine.

Division Polypodiophyta: general biological characteristics. Features of morphological organization, developmental cycle, classification. Variegated ferns, their evolutionary value as an ancestor group for gymnosperms. The use of ferns in medicine.

Division Pinophyta: general biological characteristics, origin, aromorphosis. Cycle of development of Gymnosperms. Seed ray (ovule), its structure and development in Gymnosperms, structure of pollen, the process of pollination. Seed formation. Classification: extinct (seed ferns, bennettites) and modern (cycads, ginkgoids, gnetas, conifers) classes of gymnosperms. Class conifers (Pinidae): classification, peculiarities of structure, directions of evolution. The main orders of the class of conifers (pine, cypress), the most important representatives, use in medicine.

2. Morphology of plants

2.1 Morphology of plant vegetative organs

Definition of plant organ. Vegetative and generative organs. Main morphological patterns: types of symmetry, the concept of metamorphoses.

Root. Definition of the root, development, growth, branching. Types of roots: main (primary), lateral (secondary), additional. Fibrous root system and taproot root system. Specialization and metamorphosis of roots: contractile roots, haustorial roots, aerial roots, tuberous roots, aerating roots and etc. Symbiosis of root: mycorrhiza, nodules, their importance. Morphological signs of roots used in diagnostics of medicinal plant raw materials.

Stem: definition, functions, structural parts: knot, internode, leaf axils. Leaf arrangement. Types of stems: vegetative and generative, shortened and elongated, their biological role. The position of the escape in space. Branching of shoots: monopodial, sympodial, false dichotomous. Metamorphosis of stem: above-ground and underground.

Buds: definition, classification of kidneys by function, structure, origin and location of the shoots. Morphological signs of buds used in the diagnosis of medicinal plant raw materials.

Leaf: Definition, leaf parts, functions, leaf metamorphosis. Simple and complex leaves. Morphological characterization of leaves according to complexity, veining, shape and degree of dissection of the leaf plate, the shape of the edge, tip and base. Morphological signs of leaves used in the diagnosis of medicinal plant raw materials.

2.2. Morphology of plants generative organs

Flower: definition, structure, functions. Theories of the origin of the flower. The structure of the flower. Perianth - structure, functions, types. Androceum - origin, structure, classification, functions. Gynecium - origin, structure, classification, functions. Formula and diagram of flower. Microsporogenesis and formation of male gametophyte in overgrown plants. Megasporogenesis and formation of female gametophyte in overgrown plants. Fertilization in the taxonomic plants. Change of nuclear phases and alternation of generations in the Polytoperms.

Inflorescence: definition, biological role. Structural elements of inflorescences: main and lateral axes, floral unit, bractal leaves. Classification of inflorescences: by location on plant (apical, axillary, intercalary), by degree of ornamentation (frondose, bracteose, glabrous), by presence of flower ending main axis (open, closed), by type and degree of branching (cymoid and botryoid, simple, aggregate and complex, thyrses).

Pollination in angiosperms. Adaptation of plants to different types and methods of pollination.

Seed: definition, structure, functions. Embryo structure. Classification of seeds by location of spare substances. Differences in the structure of seeds of monocots and monopartite plants.

Fruit - definition, structure, functions. Participation of different parts of flower in the formation of fruits. Classification of fruits, based on the structure of gynocele. Fruits true and false. Fruitlets. Types of fruits distribution: anemochoria, hydrochoria, zoochoria. The use of flowers, inflorescences, fruits and seeds in medicine.

3. Flowering plants systematic

3.1. Systematic review of class Magnoliopsida

Principles of plant classification. The main evolutionary systems: A. Engler, R. Wettstein, J. Hutchinson, A.L. Takhtajian. General concepts of chemosystematics. Molecular phylogenetics. APG systems.

Division Magnoliophyta: general characteristic, aromorphosis, evolutionary trends, classification. Progressive features of the organization of the overgrowths. Characteristic features of classes Liliopsida and Magnoliopsida.

Characteristic features of the organization of plants of the subclass Magnoliidae. Order Magnoliales. Family Magnoliaceae. Order Illiciales. Families Illiciaceae, Schisandraceae. Order Laurales. Family Lauraceae. Family Piperales. Family Piperaceae.

Characteristic features of plant organization of the subclass Ranunculidae. Order Ranunculales. Families Berberidaceae, Ranunculaceae, Paeoniaceae. Order Papaverales. Families Papaveraceae.

Characteristic features of the organization of plants of the subclass Caryophyllidae. Order Caryophyllales. Families Caryophyllaceae, Chenopodiaceae. Family Polygonales. Family Polygonaceae.

Characteristic features of the organization of plants of the subclass Hamamelididae. Order Fagales. Families Fagaceae, Betulaceae. Order Juglandales. Family Juglandaceae.

Characteristic features of the organization of plants of the subclass Dilleniidae. Order Theales. Families Theaceae, Hypericaceae. Family Violales. Family Violaceae. Order Cucurbitales. Family Cucurbitaceae. Order Ericales. Families Ericaceae, Vacciniaceae. Family Primulales. Family Primulaceae. Order Malvales. Families Malvaceae, Tiliaceae. Order Capparales. Family Brassicaceae. Family Salicales. Family Salicaceae. Order Urticales. Families Urticaceae, Ulmaceae, Cannabaceae.

Characteristic features of the organization of plants of the subclass Rosidae. Order Saxifragales. Families Crassulaceae, Saxifragaceae, Grossulariaceae. Order Rosales. Family Rosaceae. Order Fabales. Families Mimosaceae, Caesalpiniaceae, Fabaceae. Order Myrtales. Families Myrtaceae, Onagraceae. Order Rutales. Families Rutaceae, Anacardiaceae. Order Linales. Family Linaceae. Order Rhamnales. Family Rhamnaceae. Order Elaeagnales. Family Elaeagnaceae. Order Araliales. Families Araliaceae, Apiaceae. Order Dipsacales. Families Caprifoliaceae, Valerianaceae.

Characteristic features of the organization of plants of the subclass Lamiidae. Order Gentianales. Families Rubiaceae, Apocynaceae, Gentianaceae, Menyanthaceae. Order Solanales. Family Solanaceae. Order Boraginales. Family Boraginaceae. Order Scrophulariales. Families Scrophulariaceae, Plantaginaceae. Order Lamiales. Family Lamiaceae.

Characteristic features of the organization of plants of the subclass Asteridae. Order Asterales. Family Asteraceae. Subfamilies Tubuliflorae, Liguliflorae.

3.2. Systematic review of class Liliopsida

Characteristic features of plant organization of the subclass Alismatidae. Order Butomales. Family Butomaceae. Order Alismatales. Family Alismataceae.

Characteristic features of plant organization of subclass Liliidae. Order Liliales. Families Melanthiaceae, Iridaceae, Liliaceae. Order Amarillidales. Families Amarillidaceae, Asphodelaceae, Hyacinthaceae, Alliaceae. Order Asparagales. Families Convallariaceae, Asparagaceae. Order Poales. Family Poaceae. Order Orchidales. Family Orchidaceae. Order Zingiberales. Families Zingiberaceae, Musacaceae.

Characteristic features of plant organization of Arecidae subclass. Order Arecales. Family Arecaceae. Order Arales. Families Araceae, Lemnaceae.

4. Cytology and histology of plants

4.1. The structure of plant cell, chemical substances and osmotic properties

The main structural components of plant cells. Cell wall: definition, functions, origin, structure and chemical composition. Primary cell wall. Secondary changes of cell wall: embolism, fracture, cutinization, oscillation, mineralization. Microchemical reactions to the substances of the cell envelope. Poras, their types, meaning. Structure of the cytoplasmic membrane.

Structure of plant cell organoids. Plastids: definition, function, lamellar structure, pigments. Types of plastids: proplastids, chloroplasts, chromoplasts, leukoplasts, etioplasts. Interrelation in ontogeny. Algae plastids.

Vacuole: definition, structure, functions, formation. Composition and properties of cellular juice. Osmotic pressure, turgor, plasmolysis.

Chemical substances of the cell: classification according to their role in its vital functions, localization. Forms of stored carbohydrates in the plant cell: simple sugars, starch (its types), inulin. Starch grains - formation, structure, microchemical reactions of detection. Plants rich in carbohydrates. Forms of stored proteins and fats in the plant cell. Aleuron grains - types, structure, microchemical detection reactions. Plants rich in proteins. Fats - forms of deposition, microchemical detection reactions. Plants rich in fats. Cell excretory substances - forms of deposition (single crystals, druses, raphids, styloids, cystoliths). Significance of types of crystalline inclusions for diagnostics of plant raw materials. Significance of secondary metabolites for the production of pharmaceutical substances.

4.2 Plant tissues

The concept of plant tissues. Principles of tissue classification.

Meristems: functions, cytological features, localization in the plant body, classification by origin (primary and secondary) and localization (apical, lateral, intercalary, wound).

Covering tissues: functions, cytological features, classification. Epiblema - functions, localization, origin, structure, root hairs. Epiderma: cytological features, origin, localization. Diagnostic signs of epiderma: shape of epidermal cells proper, tortuosity of walls, type of stomatal apparatus, type and structure of trichomes. Periderm - cytological features, formation, structure, localization. Structure and functions of lenticels. Cork as a complex of periderms.

Parenchyma tissue: cytological features, classification, localization. Functions and features of structure assimilation, reserve, air, aquifer parenchyma. The purity of cells parenchymus, the causes of this phenomenon.

Secretory tissues: role in plant life, cytological features, classification, localization. Structures of external secretion: glandular hairs, essential oil glands, nectaries, hydathodes, digestive glands and their cytological features, origin, localization. Structures of internal secretion: idioblasts, receptacles (schizogenic and lysogenic), lacticians (articulate and non articulate), secretory canals, their cytological features, origin, localization. Products of secretory structures, biological role and application in medicine.

Mechanical tissues: functions, cytological features, classification, localization. Collenchyma - types (angular, lamellar, loose), peculiarities of their structure and localization. Sclerenchyma - general characteristics, properties of cell membranes, types of sclerenchyma: wood fibers, bast fibers, bark, perivascular and obvascular. Sclerenchyma - origin, cytological characteristics, species, chemical composition of cell wall, localization, importance for diagnostics of plant raw materials.

Flows of substances in the plant. General characteristic and classification of conducting tissues. Phloem as a complex tissue: histological elements, cytological features, origin, localization. Conducting elements of phloem: sieve cells, sieve tubes

with satellite cells, peculiarities of structure, localization. Xylem as a complex tissue: histological elements, cytological features, origin, localization. Conducting elements of xylem: tracheids and vessels, origin, peculiarities of structure, localization. Movement of substances through phloem and xylem.

Fibrovascular bundles - structure, classification, localization in plant organs. Conducting system of plants as a complex structural formation, evolution and types of stele structure.

5. Anatomy of plants

5.1. Anatomy of stems and rhizomes

Stem growth apex, its role in the formation of organs and tissues of the shoot. Procambium and differentiation of primary conducting tissues. Bundle and inter-bundle cambium. Features of laying and development of tissues in stems of dicotyledonous plants. Types of anatomical structure of stems of herbaceous dicotyledonous plants (bunchy, non-bunchy, transitional), the role of methods of laying of procambium and cambium in their formation.

Stem structure of herbaceous monocotyledonous plants. Stem structure of herbaceous dicotyledonous plants (primary, secondary).

Secondary changes in the stems of woody dicotyledonous plants. Structure of covering tissue and primary bark. Peculiarities of structure of secondary xylem (wood) and phloem (bast) in stems of woody dicotyledonous plants. Primary and secondary medullary rays.

Structure of perennial stems of monocotyledonous plants. Leaf traces. Types of vascular-fiber bundles. Thickening of monocotyledonous stems.

Anatomical structure of stems of coniferous plants. Differences in anatomical structure of woody dicotyledonous and coniferous plants.

Features of anatomical structure of rhizome as underground metamorphosis of stem. Anatomical structure of rhizomes of monocotyledonous plants. Anatomical structure of rhizomes of dicotyledonous plants.

5.2 Anatomy of roots and leaves

Structure of root apex. Morphological and anatomical differentiation of young root (root zone). Formation of the primary anatomical structure of the root in the suction zone, features of the structure of the central axial cylinder and the primary cortex. The importance of the pericycle in the development of lateral roots. Transition of the root from the primary anatomical structure to the secondary structure. Secondary structure of root in conduction zone in dicotyledonous plants: formation of periderm and secondary conduction tissues. Features of anatomical structure of roots of woody dicotyledonous plants. Differences in anatomical structure of roots of monocotyledonous and dicotyledonous plants.

Root crop, types of structure depending on the number of cambium layers and location of parenchyma (monocambial: xylem and phloem type; polycambial).

Anatomical structure of dorsoventral, isolateral, radial leaves and leaves of cereals. Dependence of leaf anatomical structure on external factors. Leaf conductive system and its relationship to the conductive system of the stem.

5.3 Microscopic diagnostic signs of the vegetative organs of higher plants

Microscopic diagnostic attributes of herbaceous stems: structure of epidermis (form and sizes of cells, type of stomatal apparatus, presence and structure of trichomes); location and structure of conductive tissues and SPF; location and structure of mechanical tissues; specifics of location and structure of secretory structures (receptacles, essential oil glands, glumes, idioblasts, crystalline inclusions).

Microscopic diagnostic signs of woody plant stems: structure of covering tissue (crust), lenticels; location and structure of conductive and mechanical tissues; peculiarities of location and structure of secretory structures (receptacles, essential oil glands, spleens, idioblasts, crystalline inclusions).

Microscopic signs of rhizome structure: type of structure; structure of covering tissue; type of endoderm, types of parenchyma, crystalline inclusions, types and location of conductive structures; location of mechanical tissues, secretory formations (spleens, secretory passages, receptacles).

Microscopic diagnostic signs of root: type and structure of covering tissue, presence of primary cortex, type of endoderm, structure of conductive structures; location of mechanical tissues, secretory formations (spleens, ducts, receptacles), nature of reserve substance.

Microscopic diagnostic signs of leaves: epidermal structure (size of cells, presence and location of stomata, type of stomatal apparatus, presence of motor cells, cuticle, trichomes), mesophyll characteristic (types and location), presence and type of secretory structures, conductive bundles (types, location), mineral inclusions.

ACADEMIC DISCIPLINE CURRICULAR CHART

Section, topic #	Section (topic) name	Number of hours			Self-studies	Form of intermediate assessment
		lectures (including supervised independent work)	supervised student independent work	laboratories		
	2 semester					
1	Systematics of lower and higher archegoniates	2	1	12	15	
1.1	<i>Introduction to Pharmaceutical Botany. Algae. Fungi</i>	-	-	6	6	
	Introduction to Pharmaceutical Botany. Algae Kingdom Fungi. Division Lichenes	-	-	3	3	
		-	-	3	3	
		-	-	3	3	
1.2	<i>Higher archegonial plants</i>	2	1	6	9	
	Divisions Bryophyta, Lycopodiophyta, Equisetophyta, Polypodiophyta	2	1	3	6	
	Division Pinophyta	-	-	3	3	
2	Morphology of plants	4	2	15	15	
2.1	<i>Morphology of plants vegetative organs</i>	2	1	6	6	
	Morphology of plants vegetative organs. Root. Stem	2	1	3	3	
	Morphology of plants vegetative organs. Leaf	-	-	3	3	
2.2	<i>Morphology of plants generative organs</i>	2	1	9	9	
	Morphology of plants generative organs. Flower. Inflorescence	2	1	3	3	

	Morphology of the generative organs. Seed. Fruit	-	-	3	3	Individual quiz, electronic tests
	The final lesson «Systematics of lower and higher archegoniates. Morphology of plants»	-	-	3	3	Colloquium, individual quiz, tests, electronic tests
3	Flowering plants systematic	6	3	24	27	
3.1	<i>Systematic review of class Magnoliopsida</i>	6	2	18	18	
	Systematic review of subclasses Magnoliidae, Ranunculidae	2	0,5	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens
	Systematic review of subclasses Caryophyllidae, Hamamelididae	-	-	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens
	Systematic review of subclass Dilleniidae	2	0,5	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens
	Systematic review of subclass Rosidae	-	-	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens
	Systematic review of subclass Lamiidae	2	1	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens
	Systematic review of subclass Asteridae	-	-	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens
3.2	<i>Systematic review of class Liliopsida</i>	-	-	6	9	
	Systematic review of class Liliopsida	-	-	3	3	Combined quiz, interviews; evaluation of herbarium and plant specimens;
	The final lesson «Systematics of Flowering plants»	-	-	3	6	Colloquium, tests, evaluation of herbarium and plant specimens. Credit

		3 semester					
4	Cytology and histology of plants	6	2	30	30		
4.1	<i>The structure of plant cell, chemical substances and osmotic properties</i>	2	1	12	9		
	The structure of the plant cell, cell wall and membranes	-	-	3	3	Combined quiz, tests, report on the laboratory work with oral defense, written report on the laboratory work	
	The structure of plant cell organelles	2	1	3	2	Combined quiz, tests, report on the laboratory work with oral defense, written report on the laboratory work	
	Plant cell chemical substances	-	-	3	2	Combined quiz, tests, report on the laboratory work with oral defense	
	The final lesson «The structure of plant cell, chemical substances and osmotic properties»	-	-	3	2	Colloquium, tests	
4.2	<i>Plant tissues</i>	4	1	18	16		
	Classification of plant tissues. Meristema and parenchyma tissues	2	0,5	3	3	Frontal quiz, botanical drawing evaluation	
	Covering tissues	-	-	3	3	Combined quiz, tests, botanical drawing evaluation	
	Secretory tissues	-	-	3	3	Combined quiz, tests, botanical drawing evaluation	
	Mechanical tissues	-	-	3	3	Combined quiz, tests, report on the laboratory work with oral defense, written report on the laboratory work	
	Conductive tissues. Fibrovascular bundles	2	0,5	3	3	Combined quiz, tests, laboratory work reports with their oral defense	

	The final lesson: «Plant tissues»	-	-	3	1	Colloquium, tests quiz	individual
5.	Anatomy of plants	6	4	18	20		
5.1	<i>Anatomy of stems and rhizomes</i>	4	-	9	9		
	Anatomy of herbaceous plants stem	2	1	3	3	Interviews; visual work; botanical evaluation	laboratory drawing
	Anatomy of woody plants stem	2	1	3	3	Interviews; visual work; botanical evaluation	laboratory drawing
	Anatomy of rhizomes	-	-	3	3	Interviews; visual work; botanical evaluation	laboratory drawing
5.2	<i>Anatomy of roots and leaves</i>	2	1	6	6		
	Anatomy of roots	2	1	3	2	Interviews; visual work; botanical evaluation	laboratory drawing
	Anatomy of leaf	-	-	3	4	Interviews; visual work; botanical evaluation	laboratory drawing
5.3	<i>Microscopic diagnostic signs of vegetative organs of higher plants</i>	-	-	6	7	Interviews; visual work; botanical evaluation	laboratory drawing
	Educational research work of students «Study of anatomical structure of vegetative organs of plants»	-	-	3	4	Interviews; visual work; botanical evaluation	laboratory drawing
	Microscopic diagnostic signs of vegetative organs of higher plants	-	-	3	3	Tests, colloquium.	Examination
	The final lesson «Anatomy of plants»	24	10	102	104		

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic:

1. Pharmaceutical botany: textbook / T. M. Gontova, A. H. Serbin, S. M. Marchyshyn et al.; edited by T. M. Gontova. – Ternopil : TSMU, 2018. – 380 p.

Additional:

2. Фармацевтическая ботаника: цитология, гистология и анатомия растений = Pharmaceutical botany: cytology, histology and anatomy of plants: курс лекций / Н. С. Гурина, О. А. Кузнецова, О. В. Мушкина. – Минск : БГМУ, 2017. – 79 с.

3. Фармацевтическая ботаника для иностранных студентов = pharmaceutical botany for international students : учеб.-метод. пособие / Н. С. Гурина [и др.]. – Минск : БГМУ, 2017. – 112 с.

4. Фармацевтическая ботаника = Pharmaceutical botany : практикум для специальности «Фармация». В 2 ч. Ч. 1 / О. А. Кузнецова [и др.]. – Минск : БГМУ, 2018. – 66 с.

5. Фармацевтическая ботаника = Pharmaceutical botany : практикум для специальности «Фармация». В 2 ч. Ч. 2 / Н. С. Гурина [и др.]. – Минск : БГМУ, 2018. – 40 с.

LIST OF TOPICS FOR INDEPENDENT STUDY OF STUDENTS

Basics of ecology, plant geography, geobotany

The concept of plant ecology. Ecological groups of plants in relation to light, moisture, temperature of habitat. The influence of biotic factors on plants. Life forms as a way of plant adaptation to the environment.

Areal, its types. Endemics, relicts, cosmopolitans. The concept of flora. The floristic kingdoms of the Earth. Flora of Belarus, medicinal plants of the local flora.

Phytocenosis: definition, structure, quantitative characteristics (abundance, projective coverage, density). Principles of classification of phytocenoses, dynamics of phytocenoses (succession). Methodology of geobotanical descriptions. Vegetation, latitudinal zonality and altitudinal zonation of the vegetation of the Earth, the main vegetation zones. The concept of azonal and intrazonal vegetation. Characteristics of vegetation in Belarus.

Protection of plants, principles of rational exploitation of medicinal plant populations.

Cell and tissue cultures. growth, development, vegetative propagation of plants

Callus - wound tissue, functions in vivo. Dedifferentiation of permanent tissue cells. Callus cultures, their macroscopic and microscopic characteristics. Stages of somatic embryogenesis. Practical application of cell cultures, tissues and isolated protoplasts of higher plants.

Growth and individual development, their regulation at cellular level. Stages of plant ontogenesis: latent, virginile, generative, senile. Monocarpic and polycarpic plants. The role of phytohormones in plant life. Forms of vegetative reproduction, clones. The importance of the main ecological factors for the growth and development of plants.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allotted for independent work can be used by students for:

- preparation for lectures, laboratory classes;
- preparation for colloquiums, tests and examinations in the discipline «Pharmaceutical Botany»;
- working through the topics (questions) proposed for independent study;
- study of topics and problems that are not covered in lectures;
- research and creative assignments;
- preparing thematic reports, essays, and presentations;
- completing practical assignments;
- abstracting academic literature;
- making a review of scientific literature on a given topic;
- designing information and demonstration materials (stands, posters, charts, tables, newspapers, etc.);
- making mock-ups;
- compilation of thematic selection of literary sources, Internet-sources;
- drawing up tests by students for organization of mutual control.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

Main forms of supervised student independent work:

- writing and presentation of an essay;
- making a report;
- study of topics and problems that are not covered in the lectures;
- abstracting of primary sources (sections of textbooks, collections of documents, monographs, textbooks);
- computer-based testing;
- students' tests for mutual evaluation;
- making didactic materials;
- preparation and participation in active forms of learning.

Control of controlled independent work is carried out in the form of:

- control work;
- final class, colloquium in the form of an oral interview;
- evaluation of the oral response to a question, report or problem solving;
- examination of abstracts, written reports, reports;
- checking outlines of primary sources, monographs and articles;

individual conversation.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used to diagnose competencies:

Oral form:

frontal quiz;
individual quiz;
combined quiz;
interview;
colloquium.

Written form:

tests;
reports of laboratory works.

Oral-written form:

laboratory work reports with oral defense;
credit;
examinations.

Visual form:

evaluation of botanical drawings.

LIST OF AVAILABLE TEACHING METHODS

Traditional method (lecture, laboratory practicals);

Active (interactive) methods:

Team-Based Learning (TBL);
Research-Based Learning (RBL).

LIST OF VISUAL MATERIALS

HERBARIUM SPECIMENS

Equisetophyta collection

Ferns (Polypodoiphyta) collection

Gymnospermae collection

Inflorescences collection:

Systematic review of subclasses Magnoliidae, Ranunculidae

Systematic review of subclass Caryophyllidae

Systematic review of subclasses Hamamelididae, Dilleniidae

Systematic review of subclasses Dilleniidae, Rosidae

Systematic review of subclass Rosidae

Systematic review of subclass Lamiidae

Systematic review of subclass Lamiidae, Asteridae, Alismatidae, Liliidae,

Arecidae

STEMS FIXED WITH ALCOHOL COLLECTION

ROOTS AND RHIZOMES FIXED WITH ALCOHOL COLLECTION

FLOWERS FIXED WITH ALCOHOL COLLECTION

DEMONSTRATION MATERIAL

- I. Fruits and seeds collection
- II. Forest mosses collection
- III. Collection of lichens
- IV. Chaga mushroom
- V. Tinder fungus
- VI. Morphology of the vegetative organs of plants collections
- VII. Flowers collection.
- VIII. Stem collection
- IX. Leaf collection
- X. Roots collection
- XI. Rhizomes collection
- XII. Morphology of the generative organs collection

Reagents

1. Distilled water
2. Concentrated sulfuric acid
3. Glycerol solution
4. Lugol solution
5. NaCl 10% solution
6. Sudan III solution
7. Floroglucin 1% alcohol solution
8. NaOH 3% solution
9. Chloral hydrate solution
10. Ethyl Alcohol

LIST OF CREDITING HERBARIUM**DIVISION PINOPHYTA****Order Cupressales**Family Cupressaceae

1. Common juniper – *Juníperus commúnis*

DIVISION MAGNOLIOPHYTA**Order Ranunculales**Family Berberidaceae

2. Common barberry (European barberry) – *Bérberis vulgáris*

Family Ranunculaceae

3. Monkshood (aconite) – *Aconítum napéllus*
4. Spring pheasant's eye – *Adónis vernális*
5. Alpine delphinium (candle larkspur) – *Delphínium elátum*

Order PapaveralesFamily Papaveraceae

6. Five-seeded Plume-poppy – *Macléaya cordáta*

LIST OF CREDITING HERBARIUM

7. Yellow hornpoppy – *Gláucium flavum*
8. Greater celandine – *Chelidónium május*
Order Paeoniales
Family Paeoniaceae
9. Anomalous peony – *Paeónia anomála*
Order Caryophyllales
Family Caryophyllaceae
10. Common soapwort – *Saponária officinális*
Order Polygonales
Family Polygonaceae
11. European bistort (snakeroot) – *Polýgonum bistórta*
12. Water-pepper (marshpepper knotweed) – *Polýgonum hydrópiper*
13. Spotted lady's thumb – *Polýgonum persicária*
14. Common knotgrass – *Polýgonum aviculáre*
15. Chinese rhubarb – *Rhéum palmátum*
16. Asiatic dock – *Rúmex confértus*
Order Illiciales
Family Schisandraceae
17. Chinese magnolia-vine – *Schisándra chinénsis*
Order Fagales
Family Fagaceae
18. Pedunculate oak (English oak) – *Quércus róbur*
Family Betulaceae
19. East Asian white birch – *Bétula péndula*
20. Grey alder (speckled alder) – *Álnus incána*
21. Common alder (black alder) – *Álnus glutinósa*
Order Theales
Family Hypericaceae
22. St Peter's wort – *Hypéricum quadrángulum*
23. Perforate St John's wort – *Hypéricum perforátum*
Order Violales
Family Violaceae
24. Field pansy – *Víola arvénsis*
25. Heartsease – *Víola tricolor*
Order Cucurbitales
Family Cucurbitaceae
26. Pumpkin – *Cucúrbita pépo*
Order Capparales
Family Brassicaceae
27. Mustard greens (leaf mustard) – *Brássica júncea*
28. Treacle-mustard (wormseed wallflower) – *Erýsimum cheiranthoídes*
29. Hoary alyssum – *Bertéroa incána*

LIST OF CREDITING HERBARIUM

30. Shepherd's purse – Capsélla búrsa-pastóris

Order Ericales

Family Ericaceae

31. Marsh Labrador tea – Lédum palústre

32. Common heather – Callúna vulgáris

33. Kinnikinnick – Arctostáphylos úva-úrssi

Family Vacciniaceae

34. Lingonberry (cowberry)– Vaccínium vítis-idáea

35. Swamp cranberry – Oxycóccus palústris

36. European blueberry (common bilberry) – Vaccínium myrtillus

Order Primulales

Family Primulaceae

37. Common cowslip (cowslip primrose) – Prímula véris

Order Malvales

Family Malvaceae

38. Common marshmallow – Altháea officinális

Order Urticales

Family Urticaceae

39. Common nettle (stinging nettle) – Úrtica dióica

40. Annual nettle (dwarf nettle) – Úrtica úrens

Order Saxifragales

Family Saxifragaceae

41. Badan (heartleaf bergenia) – Bergénia crassifólia

Family Grossulariaceae

42. Blackcurrant – Ríbes nígrum

43. Gooseberry – Grossulária reclináta

Family Crassulaceae

44. Golden root (orpin rose) – Rhodióla rósea

Order Rosales

Family Rosaceae

45. Black chokeberry – Arónia melanocárpa

46. Redhaw hawthorn – Cratáegus sangúinea

47. Woodland strawberry – Fragária vésca

48. Great burnet – Sanguisórba officinális

49. Common tormentil – Potentílla erécta

50. Red raspberry – Rúbus idéaeus

51. Sparkling lady's mantle – Alchemílla micans

52. Rowan (mountain-ash) – Sórbus aucupária

53. Swamp cinquefoil (purple marshlocks) – Cómарum palústre

54. Meadowsweet – Filipéndula ulmária

55. Bird cherry – Pádus racemósa

56. Cinnamon rose – Rósa cinnamómea

LIST OF CREDITING HERBARIUM

Order Fabales

Family Fabaceae

57. Woolly-blossom locoweed – *Astrágalus dasyánthus*
 58. Yellow sweet clover (yellow melilot) – *Melilótus officínalis*
 59. Sibeian peashrub – *Caragána arboréscens*
 60. Liquorice – *Glycyrrhíza glábra*
 61. Common bean – *Phaséolus vulgáris*

Order Myrtales

Family Myrtaceae

62. Manna gum (ribbon gum) – *Eucalýptus viminális*

Family Onagraceae

63. Fireweed (rosebay willowherb)– *Chamaenérion angustifólium*

Order Linales

Family Linaceae

64. Common flax (linseed) – *Línium usitatissímum*

Order Rhamnales

Family Rhamnaceae

65. Common buckthorn (purging buckthorn) – *Rhámnus cathártica*
 66. Alder buckthorn (glossy buckthorn) – *Frángula álnus*

Order Elaeagnales

Family Elaeagnaceae

67. Common sea buckthorn – *Hippóphae rhamnóides*

Order Araliales

Family Araliaceae

68. Japanese angelica-tree – *Arália mandshúrica*
 69. Chinese ginseng – *Pánax gínseng*
 70. Alaskan ginseng – *Echinopánax elátum*
 71. Siberian ginseng – *Eleutherocóccus senticósus*

Family Apiaceae

72. Anise (aniseed) – *Anísium vulgáre*
 73. Poison hemlock – *Cónium maculátum*
 74. Coriander – *Coriándrum satívum*
 75. Caraway (Persian cumin) – *Cárum cárvi*
 76. Dill – *Anéthum gravéolens*
 77. Fennel – *Foenículum vulgáre*
 78. Parsnip – *Pastinaca sativa*

Order Dipsacales

Family Valerianaceae

79. Valerian – *Valeriána officínalis*

Family Caprifoliaceae

80. Guelder-rose – *Vibúrnum ópulus*
 81. European black elderberry – *Sámucus nígra*

LIST OF CREDITING HERBARIUM

Order Gentianales

Family Rubiaceae

82. Common madder (dyer's madder) – *Rúbia tinctorum*

Family Gentianaceae

83. Lesser centaury – *Centáurium mínor*

84. Great yellow gentian – *Gentiána lútea*

Family Menyanthaceae

85. Bogbean – *Menyánthes trifoliáta*

Order Solanales

Family Solanaceae

86. Belladonna (deadly nightshade) – *Átropa belladónna*

87. Black henbane (stinking nightshade) – *Hyoscýamus níger*

88. Jimsonweed – *Datúra stramónium*

89. Bittersweet nightshade – *Solánum dulcamára*

90. Bell pepper (sweet pepper) – *Cápsicum ánnuum*

91. Potato – *Solánum tuberósum*

92. Tomato – *Lycopérsicon esculéntum*

Order Polemoniales

Family Polemoniaceae

93. Jacob's-ladder (Greek valerian) – *Polemónium coeruleum*

Order Boraginales

Family Boraginaceae

94. Common comfrey – *Symphytum officinale*

Order Scrophulariales

Family Scrophulariaceae

95. Purple foxglove – *Digitális purpúrea*

96. Woolly foxglove – *Digitális lanáta*

97. Large yellow foxglove – *Digitális grandiflóra*

Family Plantaginaceae

98. Broadleaf plantain (greater plantain) – *Plantágo májor*

99. Arenaceous plantain – *Plantágo psyllium*

Order Lamiales

Family Lamiaceae

100. Oregano (wild marjoram) – *Oríganum vulgáre*

101. Peppermint – *Méntha piperíta*

102. Motherwort (lion's tail) – *Leonúrus quinquelobátus*

103. Breckland thyme (creeping thyme) – *Thýmus serpyllum*

104. Common sage – *Sálvia officínalis*

105. Baikal scullcap – *Scutellária baicalénsis*

Order Asterales

Family Asteraceae

106. Mountain arnica – *Árnica montána*

LIST OF CREDITING HERBARIUM

107. Dwarf everlast (immortelle) – *Helichrysum arenarium*
 108. Cornflower – *Centaurea cyanus*
 109. Elecampane – *Ínula helénium*
 110. Maral root – *Rhaponticum carthamoídes*
 111. Coltsfoot – *Tussilágo fárfara*
 112. Pot marigold – *Caléndula officinális*
 113. Common dandelion – *Taráxacum officinále*
 114. Common tansy – *Tanacétum vulgáre*
 115. Absinthe wormwood – *Artemísia absínthium*
 116. Chamomile (scented mayweed) – *Matricária chamomílla*
 117. Marsh cudweed – *Gnaphálium uliginósum*
 118. Common yarrow – *Achilléa millefólium*
 119. Three-lobed beggarticks – *Bídens tripartíta*
 120. Purple coneflower – *Echinacéa purpúrea*

Order Liliales

Family Melanthiaceae

121. White hellebore – *Verátrum lobeliánium*

Order Asparagales

Family Convallariaceae

122. Lily-of-the-valley – *Convallária majális*
 123. Angular Solomon's seal – *Polygonátum odorátum*

Family Asparagaceae

124. Garden asparagus – *Aspáragus officinális*

Family Dioscoreaceae

125. *Dioscorea nipponica* Makino – *Dioscoréa nippónica*

Order Poales

Family Poaceae

126. Sweet Vernal-grass – *Anthoxánthum odorátum*
 127. Corn – *Zéa máys*
 128. Couch grass – *Elytrígia répens*

Order Arales

Family Araceae

129. Sweet flag – *Ácorus cálamus*

Order Orchidales

Family Orchidaceae

130. Common Spotted-orchid – *Dactylorhiza fuchsia*

LIST OF PRACTICAL SKILLS

Practical skill	Form of controll
Preparation and analysis of temporary microparameters of vegetative organs of plants	Interview, visual laboratory work, practical work with marking, examination
Performing histochemical reactions and interpreting results to determine chemical components of plant cell and plant tissues	Interview, visual laboratory, examination
Morphological description of a plant	Interview, practical work with a mark, examination
Diagnosis of vegetative organs by microscopic features	Interview and colloquium with marks, examination
Establishment of systematic position of plants	Interview, practical work with a mark, credit
Collection of specimens of medicinal plants and their primary processing	Interview, credit
Making, mounting, labeling of herbariums	Interview, credit

LIST OF LECTURES*2 semester*

1. Division Bryophyta, Lycopodiophyta, Equisetophyta, Polypodoiphyta.
2. Morphology of plants vegetative organs. Root. Stem.
3. Morphology of plants generative organs. Flower. Inflorescence.
4. Systematic review of subclasses Magnoliidae, Ranunculidae.
5. Systematic review of subclass Dilleniidae.
6. Systematic review of subclass Lamiidae.

3 semester

1. The structure of plant cell organells.
2. Classification of plant tissues. Meristema and parenchyma tissues.
3. Conductive tissues. Fibrovascular bundles.
4. Anatomy of herbaceous plants stem.
5. Anatomy of woody plants stem.
6. Anatomy of a root.

LABORATORY LESSONS LIST*2 semester*

1. Introduction to pharmaceutical botany. Algae.
2. Kingdom Fungi. Division Lichenes.
3. Division Bryophyta, Lycopodiophyta, Equisetophyta, Polypodoiphyta.
4. Division Pinophyta.

6. Morphology of plants vegetative organs. Root. Stem.
7. Morphology of plants vegetative organs. Leaf.
8. Morphology of plants generative organs. Flower. Inflorescence.
9. Morphology of plants generative organs. Fruit. Seed.
10. The final lesson «Systematics of lower and higher archegoniates. Morphology of plants».
11. Systematic review of subclasses Magnoliidae, Ranunculidae.
12. Systematic review of subclasses Caryophyllidae, Hamamelididae.
13. Systematic review of subclass Dilleniidae.
14. Systematic review of subclass Rosidae.
15. Systematic review of subclass Lamiidae.
16. Systematic review of subclass Asteridae.
17. Systematic review of class Liliopsida.
18. The final lesson «Systematics of Flowering plants».

3 semester

1. The structure of the plant cell, cell wall and membranes.
2. The structure of plant cell organelles.
3. Plant cell chemical substances.
4. The final lesson «Features of the structure, chemical substances and osmotic properties ».
5. Classification of plant tissues. Meristema and parenchyma tissues.
6. Covering tissues.
7. Secretory tissues.
8. Mechanical tissues.
9. Conductive tissues. Fibrovascular bundles.
10. The final lesson: «Plant tissues».
11. Anatomy of herbaceous plants stem.
12. Anatomy of woody plants stem.
13. Anatomy of rhizomes.
14. Anatomy of root.
15. Anatomy of leaf.
16. Educational research work of students «Study of anatomical structure of vegetative organs of plants». Microscopic diagnostic signs of vegetative organs of higher plants
17. The final lesson «Anatomy of a plant».

**PROTOCOL OF THE CURRICULUM APPROVAL
BY OTHER DEPARTMENTS**

Title of the discipline requiring approval	Department	Amendments to the curriculum in the academic discipline	Decision of the department, which designed the curriculum (date, protocol #)
Biology	Department of Biology	no	protocol # 2 of 14.09.2023
Pharmaceutical Latin	Department of Latin Language	no	protocol # 2 of 14.09.2023

COMPILERS/AUTHORS:

Dean of Pharmaceutical Faculty of educational institution «Belarusian State Medical University», Sc.D, Professor

N.S.Gurina

Associate Professor of the Department of Pharmacy Organization of the educational institution «Belarusian State Medical University», Ph.D

O.A.Kuzniatsova

Curriculum content, composition and the accompanying documents comply with the established requirements.

Dean of the Medical Faculty for International Students of the educational institution «Belarusian State Medical University»

13. 11. 2023

O.S.Ishutin

Methodologist of the educational institution «Belarusian State Medical University»

13. 11. 2023

S.V.Zaturanova