Ministry of Health of Ukraine
Bogomolets National Medical University
Department of Pharmacognosy and Botany

PHARMACEUTICAL BOTANY.
LABORATORY WORKBOOK

Surname, name of student _____

Course _____

Group _____

Kyiv – 2018

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Л12

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Reviewers: *S. L. Mosyakin*, Corresponding Member of National Academy of Sciences of Ukraine, doctor of biological sciences, professor, Director of M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine

I. V. Nizhenkovska, doctor of medicinal sciences, professor, Honorary Scientist of Ukraine, Head of the Department of Pharmaceutical, Biological and Toxicological Chemistry

O. Y. Konovalova, doctor of pharmaceutical sciences, professor, Head of the Department of Pharmaceutical Chemistry and Pharmacognosy of Kyiv Medical University of UAFM

Л12 **Minarchenko V. M., Dvirna T. S., Pidchenko V. T., Kovalska N. P., Makhynia L.M. Pharmaceutical Botany. Laboratory workbook** : наочний посібник. – Kyiv : Pablisher PALUVODA A. V. – 2018. – 210 p.
ISBN 978-966-437-516-7.

Workbook is intended for laboratory classes on pharmaceutical botany, according to the working curriculum and calendar thematic plan. In addition to concrete tasks workbook contains instructions on production of microslides, using of fixed material and herbarium specimens that are used at practical classes.

In order to improve student`s preparation for classes the tasks, tests and questions for self-studying of extracurricular material are proposed.

The publication foresees it`s using for studying the basic discipline – pharmaceutical botany and for processing the particular sections of professionally oriented disciplines.

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INTRODUCTION

Workbook presents a practical course on plant anatomy and morphology for students of pharmaceutical faculties of full-time training of higher medical and pharmaceutical educational institutions of III–IV accreditation levels.

According to the curriculum topics of each semantic module is divided into those that are studied in laboratory classes and those that students learn independently.

Creating this working journal, the authors set themselves the task instill in students the skills of independent research. Attention is drawn to the methods of drugs manufacturing and techniques of drawing, as the drug sketching is not only a recording of observation results but also an active research method. Workbook is based on lectures on pharmaceutical botany, developed by the authors for students of the Pharmaceutical Faculty of Bohomolets National Medical University.

Practical works are grouped in 4 thematic sections. The material is presented in a logical sequence for better perception. Each topic begins with the definition of educational goal and setting goals on theoretical knowledge and skills. Below are Methodical recommendations and a description of the work and explainations to the preparations. As pharmaceutical botany is the basic discipline, the objects are selected considering the fact that they can be used in further study of the disciplines, including pharmacognosy and science on resources of medicinal plants.

Practical works are performed by each student. The results in the form of figures, tables etc. should be submitted in the album and serve as an indicator of student`s work in class. The album includes: a) the date of practical class, b) the exact name of topic of the practical class and work, c) results - in the form of pictures, signatures of individual structures.

Workbook will facilitate student to master the full theoretical knowledge and practical skills in course «Pharmaceutical Botany».

Safety instructions during laboratory lessons

1. Be careful, follow the order and cleanliness at the workplace, follow the safety rules during the lessons of pharmaceutical botany.

2. During the lessons students must be dressed in special clothes (white coat).

3. Before you start:

a) Find out clear procedures and rules of the experiment;

b) Check availability and reliability of dishes, equipment and other items required to complete the task;

c) Release the workplace against all unnecessary items and materials.

4. Perform the work that is provided by task and do not distract yourself and other students from the work by extraneous conversations.

5. To complete the task use the dishes and instruments, issued by a laboratory assistant.

6. Heating the liquid, keep the vessel hole in the direction out from you and do not direct to the neighbors.

7. If you observe smoke, sparks or the smell of melted plastic during the work with the devices that are switched to the electric network, immediately turn off the device and inform a teacher.

8. Carefully handle the sharp object (scalpel, blades, needles).

9. Dishes that are used for experiments with organic solvents should be clean and dry before use.

10. Accidentally poured acids or alkaline solutions collect and merge in places indicated by teacher.

11. Don’t taste the chemical substances.

12. Don’t look inside the vessel hole (even tube), because in case of expulsion of fluid can occur an accident.

13. Heating the liquid, do not leave them unattended even for a short time.

14. After contact with the skin or clothing of any substance immediately stop using and wash with plenty of water.

15. When working with a microscope it is strictly forbidden to touch the working surfaces of lenses, glasses and mirrors. If any substance reaches the microscope inform the teacher immediately.

16. It is forbidden to eat and drink in the laboratory.

Student`s signature _____

CONTENT
Part I. Module I.
«Anatomy and morphology of plant»

Part II. Module II.
«Basics of taxonomy, phytoecology and geobotany»

PART I. MODULE I.
«ANATOMY AND MORPHOLOGY OF PLANT»

Practical lesson № 1.

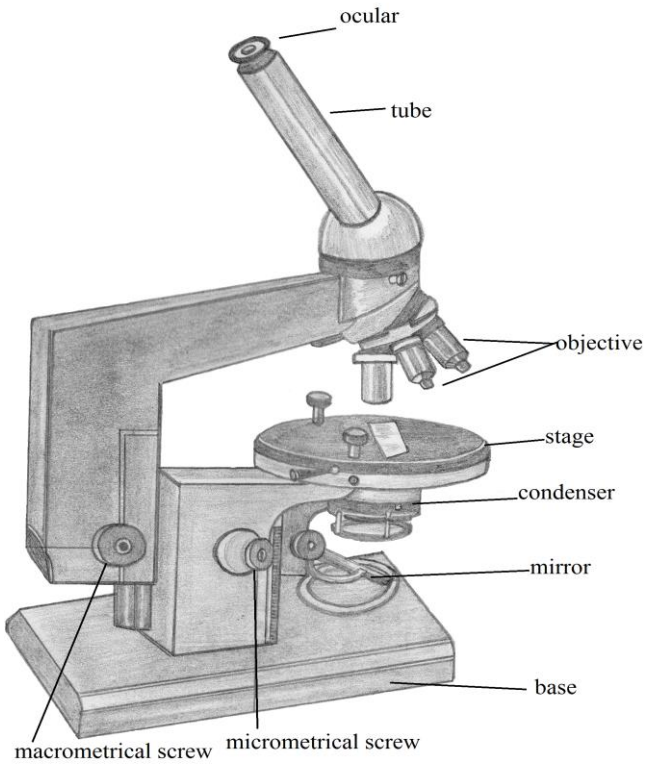
Topic: The study of organization and functions of plant cells and their diversity. Production and study of the microslides of plants.

Goals and objectives: to study the general plan of the cell composition and features of the plant cell structure; the composition and functions of organelles of the general and special functionality; the structure of a light microscope. To interpret the application of optical systems in biological researches. To explain the significance of microscopic techniques to study the biological objects and the purpose, rules of operation of the light microscope. To learn to work with a light microscope. To make temporary microscopic slides of plant objects for study by light microscopy.

Workflow

1. The study of the structure of a light microscope and the rules of working with it.

Picture 1 shows the light microscope. Observe it. What are main systems? In the table 1 put down the names of structural parts of a microscope belonging to the listed systems. Put next to each name in brackets the number that corresponds to the number on the picture.



Pic. 1. Light microscope.

TABLE 1. **Structure of a light microscope**

The basic systems of a microscope	Structural details
Mechanical	
Illumination	
Optical	

Before starting the work with a light microscope one should remember the following rules:

When a microscope is moved, it is held with one hand (right if you are right handed) by the microscope arm and the second hand (left) supports the base. This is necessary in order to avoid damaging of the mechanical part of the microscope which is sensitive to stress.

Before operating the microscope, one should check the mirror, objective lenses and eyepiece (ocular) for the absence of dirt. Wipe them with a soft clean cloth if necessary.

Starting work on an object, one should provide the best illumination of the microscope field of view: it is by looking through the eyepiece with one eye (with the other open), one should tilt the mirror in the direction of the light source so that the field of vision is lit evenly. Note that the mirror has two surfaces, flat and concave. For more intense lighting without condenser, the concave mirror surface is used. When working with high magnification of the microscope, the condenser and the flat mirror are used.

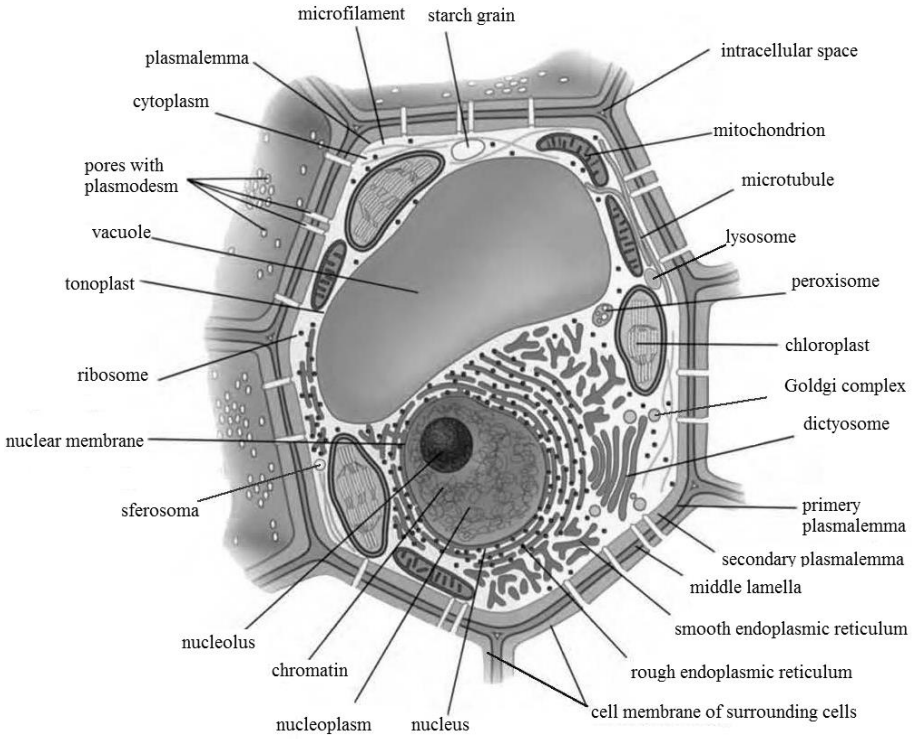
The eyepiece magnification is marked on its frame by numbers ×7; ×10; ×15. Zoom of objectives is marked with ×8; ×40; ×90, corresponding to the low, medium and high magnification. To determine the total magnification, multiply the eyepiece magnification to the magnification of the objective lens.

A specimen should be placed onto the stage with the cover slip facing upwards, and fixed with holder or slide slip.

Firstly the specimen is studied at low and medium magnification and then at high. To switch from the medium to high magnification, rotate the revolving disc, setting the lens with higher magnification. While using the immersion lens, put a drop of cedar oil on the cover slip of a slide. Looking through the eyepiece, the

small details of the object are revealed. The sharpest image is achieved by the micrometer knob.

2. *To study plant cell structure using picture* (pic. 2).



Pic.2. The structure of plant cell [16].

Full the table:

TABLE 2. The structure of plant cell.

Organelle	Sructure	Function
Plasmalemma		
Cypotlasm		
Vacuole		
Tonoplast		
Ribosome		
Lysosome		
Nucleolus		
Nucleoplasm		

Nucleus		
Endoplasmic reticulum		
Goldgi complex		
Plastids		
Mitochondrion		
Starch grain		

3. Preparing and study of the temporary specimen of fibers from the cotton seed (cotton).

Take a glass slide, put a drop of water on it and put the cotton fibers in it. Touch the edge of the drop with a cover slip and slowly lower it in a horizontal position, covering the specimen. The fluid should get on the covering glass. Observe the obtained specimen with a low (eyepiece ×10, objective lens ×8) magnification of the light microscope (Pic. 2). Find the intersection of the cotton fibers. Place the specimen with the crossing in the center of the field of vision. Observe the specimen of cotton fibers with the medium (eyepiece ×10, objective ×40) magnification and determine which fiber in the area of overlap is top and which is bottom. Find in the specimen air bubbles (if any).

In the protocol draw the cotton fibers, depicting the result of the optical section of the object. Mark on the drawing: a) cotton fibers, b) air bubbles. In the figure indicate the total magnification of the microscope.

Pic. 3. Fibers from the cotton seed (cotton).

4. Study of the temporal microslide of the juicy bulb scale leaf of the garden onion (Allium cepa).

Observe the slides of onion scales with a small (eyepiece ×10, objective× 8) magnification of the light microscope.

Find in the visual field, rectangular cells, tightly arranged in rows without intercellular spaces. Note the pronounced cell wall and cytoplasm. Draw a fragment of the slide and mark the named structures.

In the course of the practical work the teacher talks to each student in order to determine his or her ability to analyze the study the results based on the theoretical training of the student.

Pic. 4. Picture of the temporal microslide of the juicy bulb scale leaf of the garden onion (*Allium cepa*).

Signature of teacher _____

Practical lesson 2.

Topic: Structure and function of cell membranes, plastids and vacuoles with cell sap.

***Goals and objectives*:** to study the principles of composition and types of plastids; pigments of plant cells, their localization and significance; features of the structure and chemical composition of the plant cell membranes; types of secondary changes in cell membranes; types of cell membrane pits and mechanisms of their forming; the chemical composition of plant cell vacuoles. To differentiate plastids from other cell organelles in the microscopic slides. To distinguish between chloroplasts, chromoplasts and leucoplasts on slides. To differentiate simple and bordered pits on temporary slides. To identify secondary changes in the cell's membranes (lignification, suberinization, mucilaginization) using hystochemical reactions. To determine the pH of cell sap by hystochemical reactions. To identify tannins in the cell sap by hystochemical reactions.

Workflow

1. ***Chloroplasts in the leaf cells of Chlorophytum comosum.***

Take a freshly cut leaf of *Chlorophytum*. Using a scalpel or blade on the underside of the leaf, remove a thin layer of epidermis. Put it in a water drop on a glass slide and put the cover slip on.

Consider the general view of plant cells at low and high magnification and find chloroplasts. Draw them.

2. ***Chromoplasts and simple straight pits in the cells of the pulp of sweet pepper.***

Cut the fruit of sweet pepper (*Capsicum annuum*) and with a scalpel or a razor remove the inner part of the epidermis. Put it in a drop of water on a glass slide, flatten and cover with a cover slip. Observe the general view of plant cells on low and high magnifications and find chromoplasts. Note their shape, color, and draw them.

Look over the cell membrane on low and high magnifications, pay attention to their thickness and the presence of simple straight pits. Draw them.

3. ***Leucoplasts in leaf cells of white Tradescantia.***

Take a freshly cut leaf of white spiderwort (*Tradescantia*). Using a scalpel blade or a razor, remove a thin layer of epidermis from the abaxial surface of the leaf. Put it on a glass slide in a drop of water, straighten and cover with a cover glass. Observe the plant cell on low and high magnifications, find the nucleus and around it the colorless spherical structures, leucoplasts. Draw them.

4. ***Slit-like and branched pits in the stone cells of the Pyrus domestica pulp.***

Cut the pear in half, using tweezers remove the stony pulp formation, place it in a drop of water on a glass slide and cover with a cover slide. Press it to the slide glass so that the stony formation would fall apart into separate fragments. Observe the prepared microslide and find slit-like and branched pits in the walls of the stone cells with low and high magnifications. Draw the stone cells and indicate in their walls slit-like and branched pits.

5. ***Hystochemical reaction for detection of the secondary changes of cell membranes (lignification, suberinization, mucilaginization).***

- On the transverse section of woody stems of cherry or willow tree, apply a few drops of chlor-zinc-iodine reagent. The appearance of the yellow color indicates the presence of lignin in the lignified cell walls.
- In order to identify lignified walls, put a few drops of Sudan III on a bask section. As a result, orange color should to appear, which indicates the presence of suberin in cell walls.
- For detection of the mucilaginized cell walls, take marshmallow (*Althaea officinalis*) root and apply to the cut a few drops of NaOH. The appearance of lemon yellow color indicates the presence of mucus.

Record the results of the reactions to the protocol.

6. Determination of the cell sap pH.

- Take the ripe fruitlet of dark blue grapes, place it in a test tube and with a glass rod mash it to form a more or less homogenous mass. Add about 1 ml of water and a few drops of concentrated H_2SO_4. Due to changes in pH of the medium, a red color appears.
- Take some flowers of the inflorescence of *Pelargonium grandiflorum*, put them in a test tube and with a glass rod carefully grind them to form a more or less homogenous mass. Add about 1 ml of water and a few drops of NaOH. Due to changes in pH of the medium, a blue color appears.

Record the results of the reactions to the protocol.

7. Detection of tannins in the cells of the northern oak (Quercus rubra) bark.

On the inner surface of a piece of oak bark, apply a few drops of the $FeCl_3$ solution. As a result of the reaction, a black-green color will appear, which is due to the presence of tannins in the cell sap.

Record the results of the reaction to the protocol.

Signature of teacher _____

Practical lesson 3.

Topic: Types, structure and localization of storage substances and crystalline inclusions in plant cell.

Goals and objectives: to study: the types and localization of the storage substances in plant cells; types of crystalline inclusions in plant cells; the structure of various types ergastic inclusions; medicinal drugs made of plants that store in their cells proteins, fats and carbohydrates; qualitative reactions for detection of protein inclusions in plant cells; differences between fatty and essential (volatile) oils. To: differentiate the types of inclusions of carbohydrate origin in various plant species; conduct qualitative tests to detect carbohydrates in plant cells; determine the localizations of the protein inclusions; differentiate various types of crystalline inclusions in plant cells; conduct qualitative reactions for detection of fatty oils and crystalline inclusions in plant cells.

Workflow

1. ***Starch grains in cells of the grains of wheat, rice, oats and potato tubers.***

Take the grains of wheat, rice and oats and soak them in Petri plates for 4 hours. Once the grains are well swollen, cut from each a small piece and on the separate slide glasses crush each with a scalpel in a drop of water until smooth. Then cover the prepared objects with cover slips. Observe under a microscope at low magnification simple concentric (wheat), compound (rice, oats) starch grains, pay attention to the shape and location of the centers of polymerization (hila). Draw the various types of starch grains.

Take a potato tuber and cut a small piece of it. On the glass slide drip a drop of water and squeeze drops of potato juice from the freshly cut potato piece. Cover it with the cover slip and examine under the microscope at low magnification. Find the simple, compound, semi-compound and eccentric starch grains. Note the location of the center layers and shapes of starch granules. Draw them.

2. Qualitative reaction for starch and inulin.

In the specimen of starch grains in the cells of potato made before (see task 1), near the cover slip on one side, add a drop of iodine solution (3%), and to the opposite side of the cover slip attach a piece of filtering paper (in order to remove excess water). Observe the painted slide at low microscope magnification and make sure that the starch grains are colored in dark purple.

In order to identify inulin take the root of *Althaea officinalis* and put on its breach a drop of α - naphthol. The change of its color to dark purple indicates the presence of inulin (Adding iodine to the preparation will not change the color). Enter the result of the reaction to the protocol.

3. Aleuron granules in wheat grains cells.

On the permanent slide of wheat grains observe the large polygonal, thick-walled rounded cells colored yellow (iodine solution) that make up the layer located under the pericarp and peel of the fruit. They are filled with aleurone grains. Draw these cells.

4. Detection of storage fat in the cells of the common sunflower (Helianthus annuus) endosperm.

Take sunflower seeds and make a thin cut of endosperm. Put it on a glass slide in a drop of Sudan III and cover with a cover slip. Then knock faintly with a needle on the slide or slightly press it so that the drops of oil are squeezed from the cells into the edge of the cut. Sudan III is intensely absorbed by drops of oil and stain the preparation an orange red. Observe the slide on low and high

magnification. In cells, as well as in the solution that surrounds them, there are distinctive drops of oil.

5. Detection of crystalline inclusions in plant cells.

- Druses of leafstalk cells in *Begonia maculata*.

Make a transverse section of *Begoina* leafstalk. Put it on a slide in a drop of water and place the cover slip on top. Observe the object with the low and high magnification and find fused crystals, druses, in cells.

Draw these cells.

- Raphides in petiole cells of grape ivy (*Cissus rhombifolia*).

Make a transverse-cut of the grape ivy leaf petiole. Put it on a glass slide and cover with the cover slip to make raphides out of the cells. Observe the object on low and high magnification and note the large number of small needle-shaped crystals, raphides. Draw them.

- Single crystals in the cells of dry leaf scales of the *Allium cepa*.

Take a small piece of dried onion scales and place them in a drop of water on a glass slide, press down with the covering glass. Consider the object on a small and large magnification. Note that each cell has one large crystal, rod-shaped or cruciate. Draw them.

- Styloids in the cell sap of aloe (*Aloe arborescens*).

Cut the leaf of aloe and squeeze a few drops of its juice on a slide and cover with a cover slip. Observe the slide with low magnification and look out for some large needle-shaped crystals, styloids. Draw them.

- Cystoliths in epidermis of the rubber fig leaf (*Ficus elastica*).

Take a leaf of the fig and make a thin slice of the abaxial leaf epidermis. Put it in a drop of water on a glass slide and cover with a cover slip. Consider the object on low and high magnification. Find in the cells fused botryoidal crystals on a stalk, which is attached to the outer cell membrane, cystoliths. Draw them.

- Identification of calcium carbonate crystals in the cells of *Ficus elastica*.

With the specimen prepared in the previous work, remove the cover slide, drip a few drops of HCl (0,1 %) on the cut of the fig leaf epidermis. Due to the reaction of acid with crystals of calcium carbonate, there will be unstable carboxylic acid formed, which decays with the release of carbon dioxide in bubbles.

Record the results of the reaction to the protocol.

Signature of teacher _____

Practical lesson 4.

Topic: Types, structure and importance of plant covering tissues.

Goals and objectives: to study: features of the epidermis composition; the structure and function of stomata. Varieties of stomata; the peculiarities of the various trychomes types; the features of the structure and function of periderm and rhytidome. To: identify the different types of epidermal hairs on the specimens; differentiate the various types of stomata in mono- and dicotyledonous plant specimens; distinguish on slides the secondary covering tissues from the primary ones; give examples of plants that have different types of trychomes; identify the layers of periderm and rhytidome in the specimens.

Workflow

1. Simple segmented hairs of the leaf epidermis in African violets (Saintpaulia).

Take a freshly cut leaf of the African violet and with a scalpel or blade make a thin slice of the petiole epidermis. Put it on a glass slide and look at it with low microscope magnification. Note the specialized epidermal growths, the simple hairs with the segmented structure. Draw a fragment of the epidermis specimen with the simple articulated hairs.

2. Stinging hairs of the nettle (Urtica dioica) leaf epidermis.

Take a piece of the petiole or a leaf from a herbarium specimen, place it on a glass slide and observe with low microscope magnification. Find the large sharp unicellular stinging hairs, placed on multicellular stalks (emergent hairs). The very stingy hair is widened at the base, gradually tapering to the apex. Draw a fragment of the epidermis with stinging hairs.

3. Branched leaf epidermal hairs of the mullein (Verbascum densiflorum).

From a herbarium specimen of the mullein take a small piece of leaf, place it on a glass slide and observe with low microscope magnification. Find the dead multicellular branched hairs with side cells branching from the main cells. Draw a fragment of the slide with the epidermal branched hairs.

4. T-shaped hairs of the leaf (or petiole) epidermis from the grape ivy (Cissus rhombifolia).

Take a freshly cut leaf of the grape ivy; with a scalpel or blade make a thin slice of epidermis from the leaf stalk or the abaxial surface of the leaf. Put it on a

glass slide, add a drop of water and place the cover slip on top. Look at the specimen with low microscope magnification. Find unicellular T shaped hairs that cover the epidermis. Draw the fragment of the epidermis slide with T shaped hairs.

5. Stellate hairs of the epidermis of the wild olive (Elaeagnus angustifolia).

Take a fruit of the wild olive and with a scalpel remove a part of the outer layer to a glass slide. Add a drop of water, place the cover and observe the slide with low magnification. Find multicellular stellate hairs, each ray of which is a dead cell and fill a piece of the drug.

6. Tenacious bristles on the outgrowths of the Bidens tripartita seed.

Put the seed of Bidens tripartita on a glass slide and look at it with low microscope magnification. Note 2 spines located at the top and tenacious hairs that cover the surface.

Draw a fragment of epidermis with the tenacious hairs.

7. 4-rayed stellate hairs of the Capsella bursa-pastoris epidermis.

From a herbarium specimen of the shepherd's purse, break off a piece of leaf, place it on a glass slide and observe with low microscope magnification. Find the 4-rayed multicellular epidermal hairs with horizontally flattened body and draw a fragment of this micro slide.

8. Elderberry (Sambucus nigra) periderm with lenticels (permanent slides).

Using the low microscope magnification, observe the slide of the elderberry periderm. Find the lenticel, draw a fragment of the slide and mark the phellem, phellogen, phelloderm and the spongy filling tissue.

9. Anisocytic type of stomata in the leaf epidermis of a dicotyledonous plant (Hibiscus rosa-sinensis).

Take a piece of the freshly cut leaf of the Chinese hibiscus and with a scalpel or a blade make a thin slice of the abaxial epidermis. Put it on a glass slide, add a drop of water. Observe the temporary slide with low magnification. Note that the guard cells of stomata are surrounded by 3 cells, one of which is smaller than the other two. Most stomata are disordered over the entire surface. Draw the fragment of the slide, mark the guard, subsidiary and ordinary epidermal cells.

10. Tetracytic type of the stomatal complex in the leaf epidermis of the monocotyledonous plant (Chlorophytum comosum).

Take a freshly cut leaf of *Chlorophytum*. Using a scalpel or blade make a thin cut of the abaxial layer of epidermis. Put it on a glass slide, add a drop of water. Observe the temporary slide with low magnification. Please note that the guard cells are surrounded by 4 subsidiary cells, two of which are lateral and two are terminal. Unlike the dycotyledonous plants, the stomata of the leaf epidermis in the monocotyledonous plants are arranged in rows. Draw the fragment of the slide, mark the guard, subsidiary and ordinary epidermal cells.

Signature of teacher _____

Practical lesson 5.

Topic: The structure and localization of vascular and mechanical tissues in plant. Complex tissues – xylem and phloem.

Goals and objectives: to study: types of vessels, their structural features, location; distinctive features of the vessels and tracheids; features of the structure and function of the sieve tubes; components of the complex tissues, phloem and xylem; types of fibrovascular bundles, features of their structure and disposition in plants. To: identify the different types of vessels in the specimens; differentiate elements of the phloem and xylem in the fibrovascular bundles in the microslides; distinguish closed and open fibrovascular bundles in the specimens; differentiate amphicribal and amphivasal fibrovascular bundles (fascicles) in the specimens; recognize under the microscope radial fibrovascular bundles; identify bicollateral

fibrovascular bundles; give examples of plants with different types of fibrovascular bundles.

Workflow

1. ***Vascular elements in the longitudinal section of the sunflower (Helianthus annuus) permanent slides.***

At low microscope magnification observe the micro slide of the vascular elements of the longitudinal section of the sunflower stem. Find the different types of vessels, draw a fragment of the specimen, and mark scalariform, annular and spiral vessels.

2. ***Closed collateral fibrovascular bundles of corn (Zea mays) stalks – (permanent slides).***

At low microscope magnification observe the slide of the collateral fibrovascular bundles in the corn stalk cross section. The fibrovascular bundles are arranged randomly. Find a fibrovascular bundle and observe it carefully. The bundle is surrounded by uniform cells with thick walls, painted in red, sclerenchyma. Closer to the center of the stem there are three spiral and annular vessels surrounded by woody parenchyma (xylem). On the outside of the larger vessels there is phloem represented by the sieve tubes and companion cells. There is no bast parenchyma in the phloem, which is typical for monocotyledonous plants, including corn. Notice that the xylem in the section surrounds the phloem by a semicircle, which is also characteristic for the monocotyledonous plants. Xylem is located close to the center and the phloem – to the periphery. Another feature of the monocotyledonous plants is the absence of the secondary meristem, cambium.

Draw the collateral closed fibrovascular bundle and mark the phloem, xylem, and sklerenchyma.

3. ***Open collateral fibrovascular bundles of stalks of the field clover (Trifolium arvense) – permanent slides.***

At low microscope magnification observe the slide with the open collateral fibrovascular bundles on the cross section of clover stalks. The fibrovascular bundles are arranged orderly due to the bast parenchyma (phloem parenchyma). Find the fibrovascular bundle and carefully observe it. Notice the sclerenhymal cells group that strengthens the phloem outside. Under the phloem there is sclerenchyma (sieve tube cells with companion cells and bast parenchyma). Between the phloem and xylem there is a thin layer of small cells with thick cytoplasm, cambium. From the cambium to the center in the orderly radial rows there are xylem vessels, and between them there are smaller living cells, the woody parenchyma.

Draw the collateral open fibrovascular bundle and mark the phloem, xylem, cambium, wood parenchyma and sclerenhyma.

4. ***Bicollateral open fibrovascular bundles of pumpkin (Cucurbita pepo) stalks (permanent slides).***

The pumpkin stem vascular bundles are characterized by large size and lack of sclerenhyma. As part of the bundle you can see two areas of phloem – external and internal. Under the outer phloem region there is a wide cambial layer located; it consists of radial layers of small cells. Below the cambial layer there are vessels and xylem parenchyma. After the xylem there is the inner phloem region.

Draw the schema of the bicollateral open fibrovascular bundle and mark the outer and inner phloem, cambium and xylem.

5. ***Concentric fibrovascular bundles with phloem in the center (amphivasal) in roots of the Convallaria majalis (permanent slides).***

During the study of the slide, it can be seen that all the vascular bundles are collected in the center of the organ. Each one of them consists of xylem and phloem elements. Xylem's large hollow cells with thick walls are coloured in red and located as a ring on the periphery of the bundle. In the center of the bundle there is phloem, consisting of sieve tubes and companion cells.

Draw a schema of the amphivasal fibrovascular bundle and mark the phloem and xylem.

6. ***Concentric amphicribral (with xylem in the center) fibrovascular bundles in the rhizomes of the Convalaria majalis (permanent slides).***

During the study of the slide it can be seen that all the vascular bundles are gathered in the center of the organ. Each of them consists of xylem and phloem elements. Xylem's large hollow cells with thick walls are red coloured, and located as the ring in the center of the bundle. On the periphery of the bundle there is phloem, consisting of sieve tubes and companion cells.

Draw the schema of the amphicribral fibrovascular bundle and mark the phloem and xylem.

7. ***Radial fibrovascular bundle in the root of the Iris pseudoacorus (permanent slides).***

During the study of the slide, it can be seen that the bundle is located in the center of the organ. It consists of sections of phloem and xylem, alternating along the radii. A large number of radii indicates the plants belong to the class of monocotyledons.

Draw the schema of the radial fibrovascular bundle and mark the phloem and xylem.

8. ***Angular collenchyma of the cabbage (Brassica oleracea) leaf.***

Prepare a temporary slide of the cabbage leaf base cross cut in the central vein. Observe it under the microscope with low and high magnification. At low magnification one can distinguish the protruding edges of the central leaf vein that are filled with small celled tissue, which is similar to a grid of white and dark spots, alternating. With high magnification one can clearly see the white shiny thickenings of the cell walls that are interconnected thin sections. This is collenchyma. The thickenings fill the corners of the cells and form a crest inside, making the cell cavity diamond-shaped. In the collenchyma cells the live content with chloroplasts can be seen. Draw the several collenchyma cells and mark the thickened cell wall and cavity.

9. ***Sclereides (stony cells) of the pear (Pyrus).***

Take a thin slice of the pear pulp. With the dissecting needle take some pulp and mash it. Treat the material with phloroglucin and hydrochloric acid and observe under the microscope with low and high magnification. At low magnification the group of small cells with red walls that are scattered among the colorless parenchyma cells, are seen. These are sclereids. From them thin-walled elongated cells radiate. At high magnification it shows that the cell has a thick layered cell wall with narrow, occasionally branched pore channels. There is no living content in the cell cavities. Draw two or three sclereids and mark the cell wall pits and cell cavity.

Signature of teacher _____

Practical lesson 6.

Topic: The primary and secondary anatomy of the root.

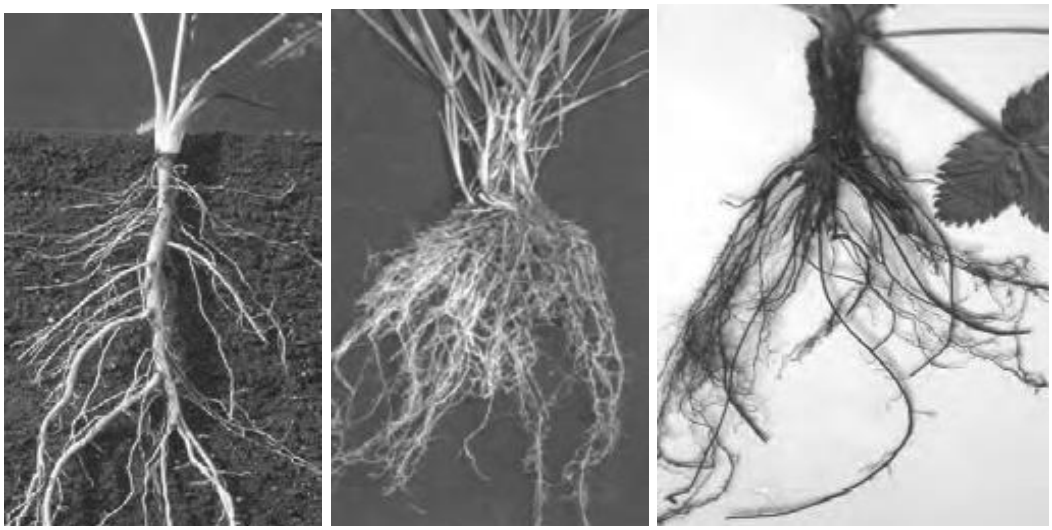
Goals and objectives: to study: terminology: root, root system, caudex, bacteriorrhiza, mycorrhiza; types of roots (main, lateral and adventitious); modifications of roots (air roots, water roots, stilt roots, contractile, roots-suckers, haustorial roots, storage roots, etc.); specialization of roots; regions of the root; primary anatomical composition of the roots of mono- and dicotyledonous plants in the zone of absorption. To: differentiate various types of roots in the herbarium specimens; distinguish between different types of root systems in herbarium specimens; distinguish modifications of roots on models; give examples of plants that have different types of variations of the root; identify specialization of roots; differentiate the root regions; distinguish the primary anatomic composition in the micro slides of roots of mono- and dicotyledonous plants in the zone of absorption; differentiate the tissues of the root system in cross-section (covering, bark, and the central cylinder).

Workflow

1. Types and forms of root systems (herbarium specimens).

By the origin several types of root systems are distinguished. The system of the main root is formed from embryonic radicle. The additional root system consists of the roots formed by stems or leaves, the mixed has both the taproot and adventitious.

Main root system usually has taproot or branched form; the system of additional roots is fibrous.



A B C

Pic. 5. The types of root system. A. – tap. B. – fibrous. C. – mixed [16].

Take a herbarium specimen of the pumpkin (*Cucurbita pepo*), beans (*Phaseolus vulgaris*) and wheat (*Triticum* spp.). Compare their root systems. The pumpkin has the clearly distinguished main root, which was formed from the embryonic radicle. It is branched with lateral roots of different orders. Thus, by its origin, it is the main root system.

In wheat the main root is not distinct among the other roots, the majority of the roots are attached to the lower part of the stem and are not the lateral branches of the main root. This root system is called the system of the additional roots.

The root system of the bean is formed from the lower part of the roots that are branched from the main root, lateral roots, and the roots from the bottom of the stem (hypocotyl), the adventitious. Thus, the bean root system is of the mixed type.

It should be noted what form the studied root systems have.

Draw the root systems of the pumpkin, wheat and bean.

2. Study of the root zones (regions) after the scheme of its cross section.

According to the structure and functionality of the root there are four histological zones in it: the zone (region) of the cell division (with the root cap), growth (stretching), absorption and conduction.

The zone of cell division includes the growth cone tip where the cell division occurs. It is protected from outside with the root cap, which protects it from damage and ensures promotion of the root in the soil. This zone consists of the thin-walled parenchyma cells of the primary meristem. Then cell division gradually ceases, and the cells are elongating. This is where the zone of growth (stretching) starts.

The dark central part of this zone is called plerome, and the outer light one is periblem. The surface layer of cells is dermatogen.

The next zone is the absorption, which is characterized by outgrowths of the epiblem cells, root hairs that absorb the solution minerals from the soil. The root hairs function for 10–20 days. In the border of the zone of absorption and transport they die, and in the zone of growth the new ones emerge. Due to that the region of the absorption shifts constantly and always is close to the root tip. In this area also the differentiation of the inside tissues takes place and the primary anatomic structure is being formed.

The region of conduction is the longest root zone reaching the root crown. The conductive tissues provide the movement of the mineral and organic matter; the pericycle forms lateral roots that anchor the plant in the soil. In this zone, the monocotyledons retain the primary structure during the whole life and dycots and gymnosperms thicken and acquire the secondary anatomical structure.

Draw the root tip and mark: root zones; dermatogen, periblem and plerome.

3. The primary root anatomy of the Iris pseudoacorus (permanent slides).

Put a permanent slide onto the stage and observe with low microscope magnification the small internal part of it, the central cylinder, and the outer, the primary cortex, which is covered with a single layer of cells with root hairs and the epiblem.

Find the outer layer of the primary cortex, exoderm that consists of tightly locked polygonal cells. Beneath it there is a layer of mesoderm, which is represented by the ground parenchyma cells that make up the bulk of the primary cortex. Epiblem and mesoderm perform the absorption function. The inner layer of the primary cortex, the endoderm, consists of one layer of cells, their radial and inner walls are thickened (due to the lignification). Please note that not all endoderm cells have an impermeable wall, among them there are thin-walled living cells and so-called passage cells (through them the water and minerals get into the central cylinder). The slide shows that the passage cells are located almost opposite the xylem rays.

The outer layer of the central cylinder, pericycle, consists of a series of live parenchyma cells that acquire the meristematic activity.

The central part of the axial cylinder is occupied by the radial multirayed vascular bundle (the polyarch one).

Draw the central cylinder with the adjacent areas of the primary bark and epiblem. Mark on the drawing the following: covering tissue, bark part (exo-, meso- and endoderm) pericycle and axial cylinder with the phloem, xylem and ground parenchyma.

4. The secondary anatomy of the pumpkin (Cucurbita pepo) root (permanent slides).

Observe the permanent microscopic slide of pumpkin with low magnification. In the middle of the root find the primary 4-rayed xylem with the larger central vessel and the smaller, sometimes even hardly visible elements, in the xylem rays. From the rays of the primary xylem the radial rays start. They are the regions with thin-walled living parenchyma formed of the cambium that originated from pericycle. The radial rays are alternating with the broad areas of the secondary xylem with the large vessels and small-celled wood parenchyma.

At the margin of the secondary xylem there is the clearly visible cambial zone, usually it is a thick layer of small thin-walled cells, ordered radially in regular rows. In the periphery of it in front of each section of the secondary xylem, the secondary phloem can be found. On the surface of the root there is a relatively small layer of cork. The tissues that are located outside of the cambium (phloem, primary parenchyma, phelloderm, cork cambium) are called the secondary bark.

Thus, the root of the secondary structure includes xylem with radial rays, cambial zone, secondary bark and cork.

Draw a schema of the pumpkin root and mark on it the primary and secondary phloem, xylem and radial rays, cambial zone, cork and covering tissue.

5. The secondary anatomy of the root of a woody plant: case study of lime, Tilia cordata root (permanent slides).

Observe with low microscope magnification the permanent slide of the lime root cross-section. The covering tissue is periderm or peel. Note that the wood

forms the rings of annual growth. Each ring is an assembly of tissues formed by the cambium during a single growth season.

The presence of the radial vascular bundle, sclerenchyma, or primary xylem vessels in the central part of the root, distinguishes the root from stems and rhizomes that have the true pith in their core.

Draw the schema of the lime root cross-section and mark the peel, annual rings, cork, wood and medullary rays.

6. Scheme of the structure of carrot (Daucus carota subsp. sativus), radish (Raphanus sativus) and garden beet (Beta vulgaris).

The root vegetables or storage roots are formed from the main root, in which the storage parenchyma expands, so that they get significantly thicker. The storage vegetables can have different types of anatomical structure, monocambial and polycambial.

Consider the schemes of various root vegetables types. Note that the storage root vegetable of the carrot has the parenchyma growth in bast, and the radish root in wood. In the roots like beets, the central cylinder initially has the primary diarch structure. Over time, the procambium develops fascicular cambium, and of the latter the secondary phloem and xylem are formed. Due to this in the central cylinder the two open collateral bundles are formed. Interfascicular cambium produces parenchyma of medullary rays. Subsequently, the formation of the secondary tissues from the cambium ceases, and the cells of the parenchyma, outside of the secondary phloem, initiate the new meristem rings that give rise to the storage parenchyma.

Thus, the dark dense layers are concentric rows of xylem vascular bundles; the light, wide layers consist of cambial zone, phloem and storage parenchyma. The beet taproot becomes polycambial.

Draw the schematic cross-section of the mentioned roots and mark the primary and secondary xylem and phloem, radial ray, parenchyma, cover tissue and cambium layers.

Signature of teacher _____

Practical lesson 7.

Topic: The shoot. Bud as the embrionic shoot The anatomy of stems of herbaceous and woody plants.

Goals and objectives: to study: terms: orthotropic shoots, plagiotropic shoots; buds: terminal, axillary, adventitious, dormant, vegetative, generative and vegetative; nodes, internodes, leaf traces, residual meristem, initial cambium, aerial stolon, tendril, runner, stem tuber, areola, cladode, phylloclade, rhizome, tuber, bulb, corm, caudex, curtain, protostele, dictyostele, actinostele; types of shoot branching (monopodial, sympodial, dichotomous); types of stem structure: bundled, transitory, non bundled; classification of buds and shoots; differences of the various types of stems (bundled, transitory, non bundled) on slides; list of the medicinal plants, which buds and stems are used as medicinal herbal raw material for obtaining medicines; anatomy of stems in the dicotyledonous woody plants. To: conduct a comparative analysis of stems of the monocotyledonous plants (maize and rye) on slides; differentiate the anatomical composition of stems of mono- and dicotyledonous plant specimens; conduct the morphological description of buds in various plants by their shape, size, top shape, color and surface characteristics, using the wet temporary slides and herbarium specimens; characterize the shoots of various plants, using herbarium specimens; identify the type of shoots branching in the herbarium specimens; give examples of medicinal plants with different types of buds and stems.

Workflow

1. The primary anatomic structure of monocotyledonous plant stems: a case study of the corn (Zea mays) stalks (permanent slides).

Observe at low microscope magnification the cross-section of the corn stem. From the outside, the stem is covered with epidermis, under which there is a thin layer of the chlorophyll parenchyma. In the older stems the cell walls lignify. The primary cortex is not pronounced. The stem has a cavity. The central part is filled with the ground parenchyma, in which there are randomly arranged vascular bundles of the collateral closed type. Please note that there is no bast phloem parenchyma. The sieve tubes and companion cells look like a reticulum. The xylem contains two large vessels and several smaller, arranged into a radial row. From the mid side of the xylem there is a cavity. Phloem is half surrounded by xylem. Cambium is absent. Around the bundle there is a layer of sclerenchyma.

Draw the schematic cross sections of the maize stem and mark: epidermis, closed collateral bundle, xylem, phloem, sclerenchyma, ground parenchyma.

2. The primary stem anatomy of the monocotyledonous plants (straw type) on the example of rye (Secale cereale) stem (permanent slides).

Observe at low microscope magnification the cross-section of the rye stem. Note the strong mechanical tissue layer, the ridges of which reach the epidermis. Between these ridges there are areas of chlorenchyma where you can see the stomatal apparatus. The primary cortex is not pronounced. Observing the slide you will see that the small closed collateral bundles are adjacent to the mechanical tissue. Closer to the center the larger bundles are placed, they are surrounded by sclerenchyma. Between the rays there is the parenchyma with big cells. In the center of the stem the core is not preserved. With its longitude growth the cells are broken and a cavity forms, which is inherent in almost all cereals.

Draw a schema of the rye stalk cross section and mark on it: epidermis, closed collateral bundle, phloem, xylem, sclerenchyma, ground and chlorophyll parenchyma, cavity.

3. Primary stem anatomy dicotyledonous plants (bundled structure): a case study of birthwort (Aristolochia clematitis) stem (permanent slides).

Observe at low microscope magnification the cross-section of the birthwort stem. Note the main stem blocks: the epidermis (consisting of rectangular and tightly packed cells), primary cortex (includes collenchyma, big-celled, thin-walled parenchyma and small-celled endoderm) and the central cylinder (starts with a wide ring of sclerenchyma of the pericycle origin). The collateral open vascular bundles are in a circular row. Xylem is colored red due to the reagent. Phloem differs from parenchyma that surrounds it, by the smaller cells. Between xylem and phloem there is the cambial zone, which consists of rectangular cells, arranged in regular radial rows. The zone of cambium between the phloem and xylem is called fascicular. The bundles (fascicules) are separated by medullary rays. In the center of the stem there is a large area of the spongy parenchyma, which is the core (pith).

Draw a schema of the birthwort stem cross section and mark on it: epidermis, primary cortex that consists of collenchyma, parenchyma and endoderm, open collateral bundle (xylem, phloem, cambium), sclerenchyma, and medullary rays.

4. Primary stem anatomy of dycotyledons (transitory structure): a case study of sunflower (Helianthus annuus) stems (permanent slides).

Observe the cross-section of the sunflower stem with low microscope magnification. Note that the vascular bundles are close to the surface of the stem in a row. All bundles seem to be interconnected with an undulating strip of very small cells with the darker content. It is the interfascicular cambium, formed from parenchyma. It gives rise to the new vascular bundles that locate between the larger bundles.

Observe the slide with higher magnification. Under the epidermis there is a mechanical tissue, collenchyma. Below it there is a small layer of the primary cortex parenchyma, ending with an undulating layer of a chain of cells adjacent to areas of sclerenchyma. It is endoderm. Thus, the primary cortex consists of collenchyma, ground parenchyma and endoderm.

Just behind the primary cortex there is the central cylinder. It begins with well segregated groups of thick-walled sclerenchyma cells with lignified walls (in the longitudinal section they look like strands) of the pericycle origin. Please note that the strands of sclerenchyma are not scattered randomly, but in combination with the collateral bundles are always adjacent to the phloem rays. The bundles are open, located evenly around the stem.

The interfascicular cambium arises from the underlying parenchyma after the procambium forms the vascular bundles and the work of the fascicular cambium starts. The interfascicular cambium forms elements of the new vascular bundle: xylem on the inside of the cambium, and phloem on the outside of it. Gradually, the new and old beams enlarge and fuse. On the inside of the bundles one can see a big celled parenchyma of the pith, which is the bulk of the stem.

Draw a schema of the sunflower stem cross section and mark on it: epidermis, primary cortex that consists of collenchyma, parenchyma and endoderm, open collateral bundle (xylem, phloem, cambium), interfascicular cambium, sclerenchyma and pith.

5. Primary stem anatomy of dicots (non bundled structure): case study of flax (Linum usitatissimum) stems (permanent slides).

Observe the cross-section of the flax stem with low microscope magnification. The surface of the stem is covered with epidermis. Under it there is the primary cortex, which consists of a thin layer of small cells x chlorophyll parenchyma and a wiggly row of the big cells of endoderm. Phloem is in a continuous layer below it. Note the continuous thick layer of xylem, which elements in the stem of flax are in regular radial rows. Between very large xylem elements, there are rows of small cells filled with cytoplasm, as a result they are a darker color. These are the medullary rays, consisting of living parenchyma cells with lignified walls. To the center from xylem there is pith, usually with a large cavity. A narrow strip of cambial zone is found between xylem and phloem.

Draw a schema of the flax stem transverse section and mark on it: epidermis, primary cortex that consists of collenchyma, parenchyma and endoderm, open collateral bundle (xylem, phloem, cambium), pith and medullar rays.

6. The secondary stem anatomy in woody plants: a case study of the lime (Tilia cordata) stem (permanent slides).

Put a permanent slide onto the microscope stage and observe with low magnification the cross-section of the lime stem. Note that next to the small central section of the pith, there are concentric circles of the annual wood rings, painted by a reagent in crimson red. A dark stripe of cambium is clearly visible next to the wood. After the cambium there are several trapezoidal sections of phloem that are crossed by sclerenchyma layers that are colored by reagent in pink. Between the

plots of phloem there are visible areas of the parenchyma, triangular-shaped with the tip pointed to the cambium, and the base to the periphery. The top of such triangle in wood is extended by the radial row of cells with dark contents, the medullary ray. In the xylem, it is represented with a single series of cells.

The parts of phloem, medullary rays parenchyma, and pericycle zone constitute together the secondary bark. From the outer side of it the primary cortex starts, which consists of: endoderm, parenchyma and lamellar collenchyma. The outer side of the stem is covered with a cork that seems to be continuous due to dark-brown cell walls.

Draw the schema of the lime stem cross-cut and mark: cork, medullary rays, xylem, phloem, sclerenchyma, parenchyma, collenchyma, annual ring.

7. Secondary stem anatomy of conifers on the example of the pine (Pinus sylvestris) stems (permanent slides).

Observe at low magnification the permanent microscope slides of the pine stem cross section. Find in the stem center a small area of thin walled parenchyma cells, pith. In the periphery of it in concentric layers there are annual rings of wood (xylem). There are resin ducts (schizogenous cavities) all around the wood, but more in the dark (autumn) plots the annual rings. The wood is crossed with radial stripes, medullary rays. Some rays are from the pith to the cortex (primary rays), others start at any annual rings of wood and sometimes do not reach the cortex (secondary rays). The boundary between the wood and the bark is the secondary cambial zone.

The secondary bark consists of primary phloem and the pericycle zone. Medullary rays in phloem consist of one row of cells, but larger ones than in the xylem. From the outer side of the phloem there are big cells of the primary cortex parenchyma. Among them there are well noted big resin canals.

Cover tissue is formed by layers of cells with thin suberized walls that alternate with the layers of cells with thick lignified walls.

Pay attention to the two structural features of pine bark: the absence of companion cells in the sieve tubes and the presence of resin canals both in primary cortex and in wood.

Draw the schema of the pine stem cross-section and mark: periderm, xylem, phloem, parenchyma, secondary and primary bark and resin ducts.

8. Modifications of the stem (herbarium specimens).

Study the herbarium specimens with various modifications of stems: rhizomes, tubers, bulbs, tendrills. Notice morphological features of each modification. Schematically, draw them and note the adventitious roots shortened stem, leaves, internodes, apical bud. Give examples of plants with the modifications.

Signature of teacher _____

Practical lesson 8.

Topic: Anatomy of a leaf.

Goals and objectives: to study: terminology: ventral and dorsal side of the leaf blade, primordia, stipule, callus, venation, sheath, phyllode, cladode, phylloclade, leaf gap, heterophylly, leaves amphistomatal, epistomatal,

hypostomatal, radial, xerophytes, hygrophytes, hydrophytes, halophytes, ephemers, ephemeroides; mechanisms of the leaves functions: photosynthesis, transpiration, gas exchange; classification of the leaf blade by the form of edge; classification of leaves from the location on the plant and type of leaf complexity; types of leaf venation; distinctive anatomical features of leaves of conifers and angiosperm plants; the essence of the adaptive nature of the metamorphosis in leaves with the example; the role of leaves and their modification as a source of medicinal plants for pharmaceutical and medicine. To: identify types of leaf blades by the shape of their margins, type of complexity, location on the plant (on herbarium specimens); differentiate the venation types in the leaves from herbarium specimens; recognize the anatomical structures of the dorsoventral leaf on the microscopic slides; identify the features of the isobilateral leaf anatomical structure on the microscopic slides; find specific anatomical features of the conifer leaf on slides; give examples of plants, which leaves' modifications (alone or together with other parts of shoots) are part of the medicinal raw material and are used in pharmacy and medicine.

Workflow

1. Dorsoventral type of the leaf blade leaf on the example of the Japanese camellia, Camellia japonica (permanent slides).

Observe the slide with the transverse section of Japanese camellia leaf with low microscope magnification. The leaf is covered with epidermis. Between the upper and lower epidermis there is a tissue composed of cells that contain chlorophyll. This is assimilation parenchyma, mesophyll. Note that under the adaxial epiderm, the cells are elongated, tightly packed, without intercellular spaces, arranged in two layers. This is columnar (palisade) parenchyma. Next to the abaxial epidermis there are more rounded cells with large intercellular spaces, the spongy parenchyma. Between the mesophillous cells, at some distance from each other there are closed collateral fibrovascular bundles. It is better to study the anatomy of the bundle on the main vein, as with the increasing of the branching, the phloem part disappears and the bundle becomes simple. Midrib occupies almost the entire thickness of the leaf. Within the bundle the robust xylem is well seen, the phloem is adjacent to it. Note that xylem faces the adaxial side of the leaf, and the phloem the abaxial.

Draw a schema of the Japanese camellia leaf cross-section and mark on it: epidermis, closed collateral bundle, xylem, phloem, sclerenchyma, mesophyll, columnar and spongy parenchyma.

2. Radial type of the gymnosperm leaf structure: a case study of the pine (Pinus sylvestris) needles (permanent slides).

Observe the slide with the transverse section of the pine leaf with low microscope magnification. The protective covers of the pine needles are made of the two layers of cells: epidermis and hypodermis. Epidermis is covered with a thick layer of cuticle. All cell walls are thickened, and have pore channels in the corners. Hypodermis consists of a single, and in the corners of two or three layers of cells with less thickened lignified walls. With low magnification one can clearly see that the central part of the leaf, which is surrounded by endoderm, there are two collateral vascular bundles. Between the vascular bundles there is the mechanical tissue, sclerenchyma. The remaining space of the central part is occupied by the transfusion tissue. Mesophyll is uniform, pierced with resin channels. Notice that the cell walls sometimes grow into its cavity, forming folds (folded parenchyma).

Draw a schema of the pine leaf cross-section and mark on it: epidermis, hypoderm, collateral bundle (xylem, phloem), sclerenchyma, folded parenchyma, resin canals.

3. Identification of macroscopic morphological features of the leaf structure (herbarium specimens).

Observe the various types of leaves in the herbarium specimens. Examine the structure of the petiolate, sessile and axillary leaves. Get acquainted with the most common forms of leaf blades in simple entire, divided with gaps, and compound leaves. Note the peculiarities of the margin forms, leaf apex and leaf plates. Indicate the features of leaves venation. Schematically draw the venation types, structure and form of simple and compound leaves.

Signature of teacher _____

Practical lesson 9.

Topic: Flower as the modified shoot. Common patterns of its structure. Variety of flowers.

Goals and objectives: to study: terminology: actinomorphic and zygomorphic flower, fertilesterile, cyclic, hemi cyclic, acyclic; perianth: hetero-, mono-, achlamideous, androecium, staminodes, gynoecium mono-, apo-, syncarpous; perianth types; varieties of the receptacles in form and structure; types and forms of the corolla; classification of the actinomorphic sympetalous corolla; classification of the actinomorphic dialypetalous corolla; types of androecium and gynoecium; the significance of the flower appearance in evolution. To: make formulas and diagrams of flowers in various plants; interpret the given formulas and diagrams of flowers in various plants; identify the type of flowers and their parts by chart and wet slides; compare the types and forms of flower calyx and corolla from various plants on tables and wet slides;differentiate the receptacles of flowers of various plants; identify the types of gynoecium and ovary position in the flowers; name the examples of plants, which flowers are used as medicinal raw material (MRM).

Workflow

1. Flower morphology (fixed material).

Take a fixed flower of *Rosa majalis*. Make sure that through this flower multiple axes of symmetry can be drawn, therefore the flower is actinomorphic. Dissect the flower and find the calyx and corolla (the flower has a double perianth). Count the number of petals and sepals and note that all the elements flowers are free. Find in the flower stamens and pistil and find that the flower is bisexual. Count the number of stamens and specify the type of androecium. Isolate the pistl, specify its components. Make a transverse section of the ovary and define the type of gynoecium. Draw the flower parts and indicate its formula.

Take a pea (*Pisum sativum*) flower. Make sure that this flower has only one axis of the symmetry, therefore it's a zygomorphic flower. Dissect the flower and find the calyx and corolla (the flower has a double perianth). Count the number of petals and sepals and note that all elements of the flower are connate. Find in the flower, stamens and pistils, make sure that the flower is bisexual. Count the number of stamens, number of connate and free stamens, specify the type of androecium. Take out the pistil and specify its components. Make a transverse section of the ovary and define the type of gynoecium. Draw the flower parts and indicate its formula.

Take a fixed flower of *Convallaria majalis*. Make sure that this flower has several axes of symmetry, therefore the flower is actinomorphic. Dissect the flower and find the corolla (the flower has a single perianth). Count the number of petals and note that all the elements flowers are connate. Find stamens and pistil in the flower and find that the flower is bisexual. Count the number of stamens and specify the type of androecium. Separate the pistil, specify its components. Make a transverse section of the ovary and define the type of gynoecium. Draw the flower parts and indicate its formula.

Take a flat flower of cucumber (*Cucumis sativus*). Make sure that these flowers have several axes of the symmetry, therefore it is a zygomorphic flower. Dissect the flower and find the calyx and corolla (the flower has the double perianth). Count the number of petals and sepals and note that all elements of the flower are connate. Find in one flower, stamens, and pistils in another, make sure that the flowers are unisexual. Count the number of stamens and specify the type of androecium in the male flower. Take out the pistil from the female pistillate flower and specify its components. Make a transverse section of the ovary and identify the type of gynoecium. Draw the flower parts and indicate their formulas.

Take a fixed specimen of goat willow (*Salix caprea*). Make sure that this flower has several axes of the symmetry, therefore it's an actinomorphic flower. Dissect the flower and see that the calyx and corolla are absent. The flower is naked or incomplete. Find in the flower, stamens and pistils, make sure that the flower is bisexual. Count the number of stamens and identify the type of androecium. Take out the pistil and specify its components. Make a transverse section of the ovary and define the type of gynoecium. Draw the flower and indicate its formula.

Take a fixed specimen of sage (*Salvia officinalis*). Make sure that this flower has only one axis of the symmetry, therefore it is a zygomorphic flower. Dissect the flower and find the calyx and corolla (the flower has a double perianth with the bilabiate corolla). Count the number of petals and sepals and note that all elements

of the flower are connate. Find in the flower stamens and pistils, make sure that the flower is bisexual. Count the number of stamens, specify the type of androecium. Take out the pistil and specify its components. Make a transverse section of the ovary and define the type of gynoecium. Draw the flower parts and indicate its formula.

Take a fixed specimen of the blue cornflower (*Centaurea cyanus*) flower. Make sure that this flower has only one axis of the symmetry, therefore it is a zygomorphic flower. Dissect the flower and find the calyx and corolla (the flower has the double perianth). Count the number of petals and sepals and note that all elements of the flower are connate, and the elements of the calyx are reduced to the bristled pappus. Note that the flower has no reproductive organs, the flower is sterile. Draw the flower parts and indicate their formulas.

2. Syncarpous gynoecium on the example of the two-leaf squill, Scilla bifolia (permanent slides).

Observe the fixed slide of the squill ovary cross section under a microscope with low magnification. Note on the section three clearly visible carpels, which are connate with their side walls. This means that the gynoecium is syncarpous, the ovary is trilocular with angular placentation.

Draw the cross-section of the ovary and mark its wall, locule, ovule, and placenta.

3. Types of perianth, corolla, androecium and gynoecium (herbarium specimens).

Draw charts showing the types perianth, corolla, androecium and gynoecium naming examples of plants, using the herbarium specimens.

Signature of teacher _____

Practical lesson 10.

Topic: Inflorescence as a shoot or shoot system.
The composition and classification of inflorescences.

Goals and objectives: to study: the terms of inflorescence: apical, axillary, intercalary, monopodial, botryoid, sympodial, cymose, thyrse, monochasium, dichasium, pleiochasium; classification of inflorescences by the placement on plant, the degree and type of branching, and morphological characteristics of bracts, sex of the flowers, orientation of the main axis; distinctive features of simple and compound inflorescences; the significance of flower development in evolution; the significance of the inflorescences, primarily as a source of herbal medicinal raw material used in pharmacy. To: recognize the types of inflorescences by schemes and herbarium specimens; differentiate leafy, bracteate and ebracteate inflorescences by the herbarium specimens; compare monopodial and sympodial inflorescence; compose the inflorescences schemes; give examples of plants with various inflorescences.

Workflow

1. Definitions of inflorescences (herbarium specimens).

Consider the herbarium specimen of *Plantago major* and study its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Please note that the flowers have no pedicel and are sessile on the axis of the first order. It indicates that this inflorescence is a spike. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the spike belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Consider the herbarium specimen of the red clover (*Trifolium pratense*) and study its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Please note that the flowers have no pedicel and are sessile on the horizontally expanded axis of the first order. It indicates that this inflorescence is a head. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the head belongs, depending on the growth pattern and branching. Name several examples of plants that have the same inflorescence.

Study the herbarium specimen of dandelion (*Taraxacum officinale*) and study its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Note that the tip of the main axis expands forming the receptacle and the condensed flowers of the first order are attached to it. It means that the inflorescence is a calathid (capitulum). Draw the diagram of the inflorescence. Specify to which group of the generative shoots the capitulum

belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Consider the herbarium specimen of pear (*Pyrus* sp.) and explore its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Please note that the main axis is well developed or slightly shortened, flowers alternate, pedicels of the lower flowers are longer than the upper, making the flowers undertake the same level. It means that the inflorescence is corymb. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the corymb belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Observe the *Convallaria majalis* herbarium specimen and study its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Note that on the axis of first order there are flowers on pedicels that turned into the same side of the axis and usually are of the same length. These indicate that this inflorescence – unilateral raceme. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the unilateral raceme belongs, depending on the growth pattern and branching. Name more examples of plants that have the same inflorescence.

Consider the herbarium specimen of wild carrot (*Daucus carota*) and study its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Note that the distance between the second-order stems are shortened and they are attached to the tips of the stems of the first order. Distances between the peduncles and flowers are also shortened and flowers are on the tips of the secondary stems. This indicates that this inflorescence is the compound umbel. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the compound umbel belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Observe the herbarium specimen durum wheat (*Triticum durum*) and study its inflorescence. Determine the inflorescence by the degree and type of branching (simple or compound). Please note that main axis is branched with the secondary one with sessile flowers. The lateral axes are called spikes. This indicates that the inflorescence is the compound spike. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the compound spike belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Consider the herbarium specimen of rowan (*Sorbus aucuparia*) and study its inflorescence. Determine the inflorescence by the degree and pattern of branching (simple or compound). Please note that it is composed of simple corymbs. This indicates this inflorescence is the compound umbel. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the compound umbel belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Consider the herbarium specimen of potato (*Solanum tuberosum*) and explore its inflorescence. Determine the inflorescence by the degree and pattern of branching (simple or compound). Please note that the main axis ends with a flower and below it the axis of the second order forms, which also ends with a flower. The axes are directed in the same direction. This indicates that this inflorescence is drepanium. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the drepanium belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Consider the herbarium specimen of milkweed (*Euphorbia virgata*) and study its inflorescence. Determine the inflorescence by the degree and type of

branching (simple or compound). Note that under the flower, which is located on top of the main axis, the two opposite axes are formed, each of them also has a terminal flower. This means that the inflorescence is dichasium. Draw the diagram of the inflorescence. Specify to which group of the generative shoots the dichasium belongs, depending on the growth pattern and branching. Name several more examples of plants that have the same inflorescence.

Signature of teacher _____

Practical lesson 11.

Topic: The structure and classification of fruits.

Goals and objectives: to study: terms: pericarp, exo-, meso-, endocarp; the fruit types: apocarpous, syncarpous, pseudomonocarpous, schizocarpous; micropile, funiculus, spermoderm, perisperm, stratification, scarification; definition and biological role of fruits and seeds; the characteristics of mono-, apo - and syncarpous fruits; structural and functional characteristics of the fruit; classification of fruits based on their morphology. To: classify the types of fruits by the morphogenetic characteristics; differentiate the types of fruits by the structural and functional characteristics; compare simple and compound apocarpous fruit; recognize the structures of seeds on slides; compare the structure of seeds of mono- and dicotyledonous plants; name the examples of plants, which fruits and seeds are used as a medicinal raw material; prove the significance of the fruits and seeds used in pharmacy, medicine.

Workflow

1. Study of the morphological features of the fruit (fruit collection).

Take a cross-section of apple (*Malus domestica*) or pear (*Pyrus* sp.) and study its structure. Identify the fruit by morphological (dry, fleshy, one-seeded, polyspermous; dehiscent, indehiscent) and morphogenetic (monocarpous, apocarpous, syncarpous) classifications. The fruit of the apple tree, pome, is fleshy, polyspermous, indehiscent. The exocarp is leathery, mesocarp is fleshy (containing

stone cells in pear), the endocarp is leathery, lining the inner walls of the 5-locular ovary, thus the fruit is syncarpous.

Draw the structures mentioned above. Name some examples of plants that have the same fruit.

Take a cross-section of the cherry (*Prunus avium*) fruit and study its structure. Identify the fruit by morphological and morphogenetic classifications. The cherry fruit, drupe, is fleshy, one-seeded, indehiscent. The exocarp is leathery, mesocarp is fleshy, the endocarp is woody, fruit is monocarpous.

Draw the structures mentioned above. Name some examples of plants that have the same fruit.

Make a cross-section of rose hips (*Rosa canina*) and study its structure. Identify the fruit by morphological and morphogenetic classifications. The fruit of the rose hips, cynarrhodion, is juicy, polyspermous, indehiscent. In cynarrhodion the fruitlet nuts are loose, compactly placed in cup shaped hypanthium, thus the fruit is apocarpous.

Make a cross section of the sweet orange (*Citrus sinensis*) fruit and study its structure. Identify the fruit by morphological and morphogenetic classifications The fruit of the sweet orange, hesperidium, is fleshy, polyspermous, indehiscent. Exocarp is leathery, colorful, with ether-oil containers, the mesocarp is spongy, white, the endocarp is represented by large, juicy follicle cells, therefore the fruit is syncarpous.

Draw the structures mentioned above. Name some examples of plants that have the same fruit.

Carefully split the fruit of hazel (*Corylus avellana*) and study its structure. Identify the fruit by the morphological and morphogenetic classifications. The hazel fruit is a nut, dry, one-seeded, indehiscent. It develops from bilocular gynoecium, its pericarp sclerifies to a great extent and bears one seed, so the fruit is syncarpous.

Draw the structures mentioned above. Name some examples of plants that have the same fruit.

Make a longitudinal section of the sunflower (*Helianthus annus*) fruit and study its structure. Identify the fruit by the morphological and morphogenetic classifications. The fruit of the sunflower, achene, is dry one-seeded, indehiscent. It has leathery, more or less hard pericarp, formed from syncarpous gynoecium, so the fruit is syncarpous.

Draw the structures mentioned above. Name some examples of plants that have the same fruit.

Make a longitudinal section of the fruit of durum wheat (*Triticum durum*) and study its structure. Identify the fruit by morphological and morphogenetic classifications. The fruit of the durum wheat, caryopsis, is dry one-seeded, indehiscent. Thin pericarp is tightly attached or fused with the seed coat. The fruit is developed of the superior ovary of 2 carpels, so it is syncarpous.

Draw the structures mentioned above. Name some examples of plants that have the same fruit.

2. The structure of the seed with endosperm: a case study of the oat (Avena sativa) caryopsis (permanent slides).

Observe the permanent slide of the oat caryopsis (longitudinal section) at low microscope magnification. The outer layer of the grain is represented by pericarp that is fused with the spermoderm. Examining the slide, find two very different parts of the grains: the embryo and endosperm. Note that the size of the embryo is small compared to the size of the endosperm. This is because the storage compounds are deposited in the endosperm, not in the embryo. Note that the embryo consists of primary meristem and has the initials of the vegetative organs of the future plant: embryonic radicle with the root cap, root sheath, coleorrhiza, embryonic stem, hypocotyl and plumule. In the center of the plumule there is the stem growth cone, clearly visible, covered with embrionic leaf. The outer embryonic leaf is called coleoptile. Find the cotyledon scutellum. In the peduncle opposite to the sculellum epiblast (reduced cotyledon) is located. Then observe the endosperm as well. Its peripheral part under spermoderm you can see clearly visible uniform layer of cells, the aleurone layer. Its cells contain protein granules, the aleuron grains. The cells under aleurone layer (the center of the slide) are filled with compound starch grains.

Draw the longitudinal section of the seed with endosperm and mark: spermoderm, pericarp, embryo, endosperm, coleorrhiza, pedicle, plumule, coleoptile, scutellum, epiblast.

Signature of teacher _____

INDEPENDENT WORK

Topic 1.
Subject, methods and objects the history of botany. Pharmaceutical botany is the modern direction of plant science.

I. Actuality of the topic.

Botany is the branch of biology concerned with the scientific study of plant life and development. Botany encompasses a multitude of scientific disciplines that study plants, algae and fungi including growth, reproduction, metabolism, development, diseases, chemical properties, and evolutionary relationships between the different groups. One of the oldest sciences, the genesis of Botany can be linked to the tribal quest of distinguishing edible, medicinal and poisonous plants. Today the scope of botany has enlarged to cover more than 550000 species.

Pharmaceutical Botany: It deals with systemic botany, in this system it investigates botanical properties of the medical, toxic and useful plants, and determined their place, distribution, active ingredients, uses and values in this system.

II. Learning objectives:

To:

- know the definition of botany and some botanical disciplines: taxonomy, morphology, ontogenesis phylogenetic, morphology, anatomy, ecology, resource studies, space botany, bioethics, pharmaceutical botany;
- determine the object, methods and objects of botany;
- distinguish between morphological and anatomical characteristics of plants;
- allocate tasks of phytogeography, phytocenology, paleobotany, resource studies, pharmaceutical botany;
- formulate importance of botany as a whole and its individual sections, including pharmaceutical botany in pharmaceutical education system
- determine the perspective of botany;
- characterize the historical stages of plant science;
- note the contribution of prominent biologists, botanists, doctors, etc., to the development of botany;
- identify achievements of fundamental sciences of the twentieth century, who have advanced botany.

Task 1. Answer the questions.

1. Botany studies ….	
2. Name the known botanical discipline.	
3. What are the branchesof botany study distribution plants on Earth and explore the vegetable group?	
4. What are the objects of botany?	
5. What does study the systematics of plants?	
6. Name the research methods that introduced in botany.	
7. What is the Pharmaceutical Botany?	
8. Give the names of domestic and foreign scientists who have made significant contributions to the development of botany.	
9. Who are the scientists first started binary nomenclature for plants?	
10. Describe the value of botany as a whole and its individual parts.	

Task 2. Choose the correct answer in tests.

1. What questions do study botany?	A. external structure of plants B. distribution plants on the globe C. the internal structure of mushrooms D. features of life of simplest E. anatomy of lichens.
2. What is the object of algology?	A. Mushrooms B. Algae C. Higher plants D. Gymnosperms E. Ferns.
3. Lichenology as the section of botany, researches the structure and characteristics of life …	A. mushrooms B. bacteria C. virus D. higher spore plants E. lichen.
4. Bryology studies questions of morphology, anatomy and physiology …	A. mushrooms B. bacteria C. moss D. higher spore plants E. lichen.
5. A variety of modern classification, which is based on the use of chemical features subcontracting natural groups are ...	A. chemotaxis B. chemosynthesis C. chemotaxonomy D. chemotropism E. chemotrophy.
6. Section of botany, studies the change of external plants during ontogenesis and phylogeny, called ...	A. histology B. anatomy C. morphology D. cytology E. physiology.
7. Science that studies the structure and function of cells, called:	A. histology B. anatomy C. morphology D. cytology E. physiology
8. Science that studies the structure and function of tissue, called:	A. histology B. anatomy C. morphology D. cytology E. physiology.

9. Objects of dendrology as one of the branches of plant science, is ...	A. trees, shrubs B. herbs C. liana D. water plants E. mushrooms.
10. The author of the elementary theory of botany is …	A. De Candolle B. K. Linnaeus C. G. Lamark D. Ch. Darvin E. M. Vavilov.

Signature of teacher _____

Topic 2.
The essence and significance of photosynthesis. Photosynthetic pigments. Light and dark phases. The end products of photosynthesis.

1. Actuality of the topic.

Photosynthesis is a unique process that is inherent to plants and some bacteria. It plays an important role in the energy of the biosphere. This is a single process in the world, which is in the colossal scale and associated with the conversion of light energy of the sun into energy of chemical bonds. The energy stored by green plants, is the basis for all life of heterotrophic organisms from bacteria to humans. Through photosynthesis, the accumulation of organic matter, provided the consistency of content in the atmosphere of oxygen and carbon dioxide, the formation of the ozone layer of the screen.

So, no doubt understanding the importance of this process for living organisms in general and the need to study the mechanisms of photosynthesis in the course of pharmaceutical botany.

II. Learning Objectives:

To:

- know the definition of photosynthesis.
- know that cell structures and chemicals provide photosynthesis.
- understand the laws of light absorption during photosynthesis.
- characterize the processes during light and dark phases.
- give the total equation of photosynthesis.
- allocate the features of photosynthesis in prokaryotic.
- explain the dependence of photosynthesis on environmental factors: temperature, carbon dioxide concentration, etc.
- prove the importance of photosynthesis.

Task 1. Answer the questions

1. Give the definition of photosynthesis.	
2. Which organisms are photosynthesis?	
3. What are the cellular structures and chemicals provide photosynthesis?	
4. What are the photosystem I and II?	
5. What is the light phase of photosynthesis?	
6. Give the reaction of water photolysis.	
7. What is characterized the dark phase of photosynthesis?	
8. What is the Calvin cycle?	
9. Give the total equation of photosynthesis.	
10. What is the significance of the photosynthesis for biosphere?	

Task 2. Choose the correct answer in tests

1. Photosynthesis is autotrophic process by which organic substances are formed. This process occurs in ...	A. chromoplasts B. chloroplasts C. chromatin D. mitochondria E. nucleus.
2. In the process of photosynthesis taking directly involved pigments of plastid. Name them.	A. chlorophyll B. anthocyanins C. phycobilins D. carotenoids E. antohlor.
3. Photosynthesis takes place in specialized organelles – green plastids. So it can not take place in ...	A. fungi B. moss C. algae D. gymnosperms E. horsetail.
4. The ultimate aim of photosynthesis is the formation of carbohydrates, which occurs when	A. light phase B. photolysis of water C. the excitation of electrons in photosystems I D. phosphorylation of ADP to ATP E. Calvin cycle.
5. The final products of photosynthesis are	A. Carbohydrates and CO_2 B. Carbohydrates, CO_2 and O_2 C. Proteins and carbohydrates D. Carbohydrates and O_2 E. Proteins, nucleic acids and O_2.
6. Organisms capable to carry of photosynthesis ...	A. blue-green algae B. nitrophilous bacteria C. iron bacteria D. green bacteria E. cyanobacteria.
7. Due to light energy in photosynthetic cells formed molecules that are a kind of accumulators of energy. These molecules are ...	A. DNA and ATP B. DNA, RNA та ATP C. ATP та $NADP^+$ D. CO_2 and ATP E. H_2O, $NADP^+$ and ATP.
8. The source of electrons in molecules during photosynthesis is ...	A. dioxide B. chlorophyll C. waters D. protein

	E. DNA.
9. The process of splitting the water molecules during photosynthesis, in which electrons are formed, called ...	A. photolysis B. acceptance A. Calvin cycle B. hydrolysis C. aquation.
10. The reaction centers of photosystem I and II in the process of photosynthesis, represent complex ...	A. chlorophyll and carbohydrate B. chlorophyll and protein C. carotenoids and protein D. carotenoids and chlorophyll E. phycobilins and chlorophyll.

Task 3. Fill the table.

The presence of certain pigments in the respective groups of plants mark the sign «+»

Organisms	**chlorophyl**				**phycobilins**		**carotenoids**	
					phycoerythrin	**phycocyanin**	**carotenes**	**xanthophylls**
Higher plants, pteridophytes, bryophytes								
Chlorophyceae (green algae)								
Phaeaphyceae (brown algae)								
Bacillariophyceae (diatoms algae)								
Rhodophyceae (red algae)								
Cyanophyceae (cyanobacteria)								

Signature of teacher _____

Topic 3.
Structural and functional organization of the cell. Features of the structure of bacterial cells, plants and fungi. Methods of reproduction of plant cells and their significance.

I. Actuality of the topic.

The cell is the elementary structural and functional unit of living organisms. It is a complex biological system in which appeares all the basic properties of living. The cells of all existing organisms, irrespective of their belonging to a Kingdom have many common structural features and similarities of physiological processes. However, they also have significant differences, and it provides diverse possibilities of organisms that consist of such cells.

Knowing the structure of cells and features specific to the cells of bacteria, plants and fungi, organisms which form the subject matter of botany, can know and understand the laws of the processes occurring at the level of cells and at the level of the body.

That is why the the study of this topic makes the basis for the subsequent mastery of a number of pharmaceutical sciences.

II. Learning objectives:

To:

- know the definition of cell
- explain the main provisions of cell theory
- conduct comparative characteristics of pro- and eukaryotic cells
- compare the structure of bacterial, plant cells and fungal cells
- characterize the structure and functional significance of cell organelles.

Task 1. Answer the questions.

1. Give definition of cell.	
2. What is the biological significance of mitosis and meiosis?	
3. What organisms are belong to	

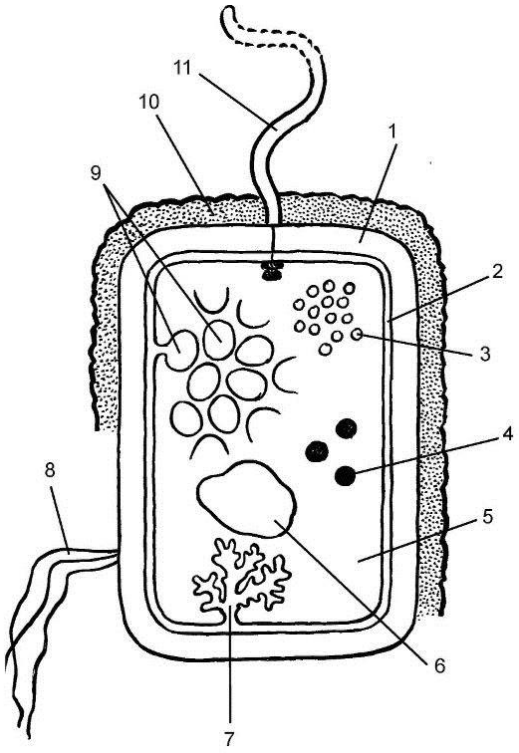
prokaryotes?	
4. What is different structure prokaryotic from eukaryotic cells?	
5. Describe the structure and function of organelles call for general use.	
6. Give examples the organelles of special purpose. Which of organisms is they characterized?	
7. Name membrane cell organelles.	
8. Name nonmembrane cell organelles.	
9. What are the the nucleus functions?	
10. What is the structure of the plasma membrane?	

Task 2. Choose the correct answer in tests.

1. Plant cells contain membrane and non-membrane organelles. Among non-membrane belongs ...	A. chloroplasts B. ribosome C. Golgi complex D. mitochondria E. vacuoles.
2. Using electron microscope detected in the cell two-membrane organelles as a sticks. The outer membrane is smooth and the inner formed protrusion inside organelles. These organelles is	A. Golgi complex B. centrosome C. lysosomes D. vacuoles E. mitochondria.
3. Plant cells differ from animal by the presence ...	A. plasmolemma B. cytoplasm C. vacuoles D. cell wall E. lysosomes.
4. Plant cells differ from cells of the fungus by ...	A. larger ribosomes B. presence the nucleus C. the absence of chitin in the cell wall D. the presence EPR E. smaller vacuoles.
5. The cell wall contains mureine in ...	A. fungi B. bacteria C. animal D. lower plants E. higher plants.
6. What substances are synthesized in the membranes of granular endoplasmic reticulum?	A. carbohydrates B. nucleic acid C. organic acids D. lipids E. protein.
7. Name the function, which does not carry out Golgi complex.	A. forming subunits of ribosomes B. forms lysosomes C. formed from membranes of the endoplasmic reticulum D. participates in the formation of complex carbohydrates E. concentrate and dehydrate products formed in the cell.
8. What substances is the part of the plasmolemma?	A. proteins, neutral fats B. proteins, phospholipids, RNA

	C. glycoproteins, glycolipids, nucleic acids D. phospholipids, proteins, glycoproteins, glycolipids E. DNA, phospholipids, proteins.
9. The cell center is contained in cells ..	A. bacteria B. higher plants C. lower plants D. fungi E. blue-green algae.
10. Specify the stage of mitosis course of which in plant cells differs significantly from that of the animal.	A. cytocinesis B. prophase C. anaphase D. telophase E. metaphase.

Task 3. Sign the names of the structures numbered in figures.



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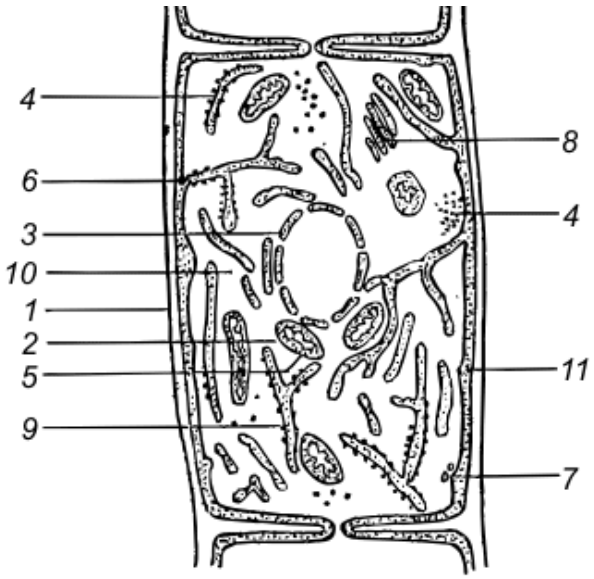
Pic. 6. The cell of bacteria [17].



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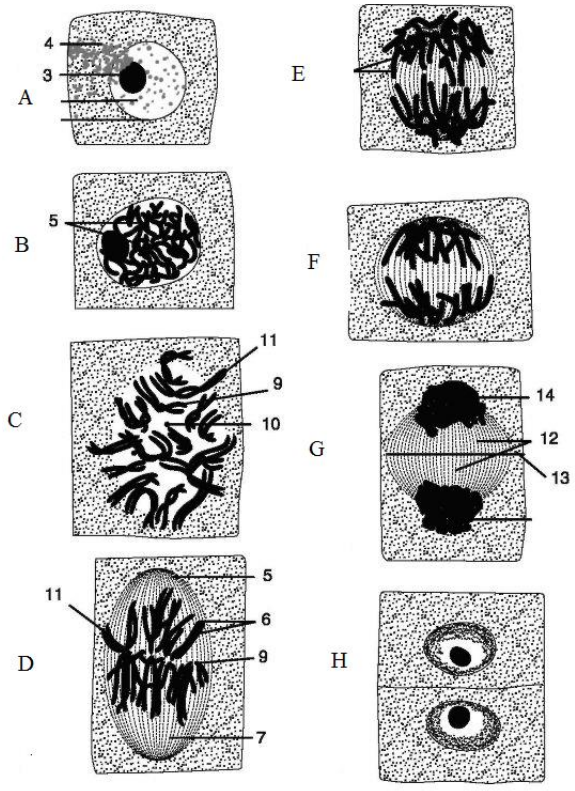
Pic. 7. The cell of fungi [10].

Task 4. Specify the mitosis phase of plant cell.



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Pic. 8. The mitosis phase [25].

Signature of teacher _____

Topic 4.
Meristematic and excretory tissue.

I. Actuality of the topic.

In the process of their professional activities a pharmacist should be able to conduct microscopic analysis of medicinal plants. Master the techniques of microscopic analysis of plant cells and tissues (including generators and excretory) is necessary to determine the diagnostic features of different taxa.

II. Learning objectives:

- types of meristems.
- theory of the formation of apical meristem.
- features of location of the primary and secondary meristems in different plants and their organs.
- structural features of secretory tissues and structures.
- types of exogenous structures.
- varieties endogenous structures.
- the distinctive features of hydatode and stomata.
- mechanisms of formation lysogenic and schizogenous conceptacle.
- especially the formation of dairy producers
- products of metabolism that accumulate in the glands of external and internal secretion.

Task 1. Answer the questions.

1. Name the tissue, the main feature of which is the permanent division of cells.	
2. At the top of the shoot is tissue, cells which divide continuously. In this mass of cells distinguish two areas: external (from her formed primary covering tissue) and internal (from it formed all other tissues of shoot). Name these zones.	
3. From which meristem tissue are formed primary phloem and xylem elements?	
4. Name the types of secondary lateral meristem.	
5. What is the function of the cambium?	

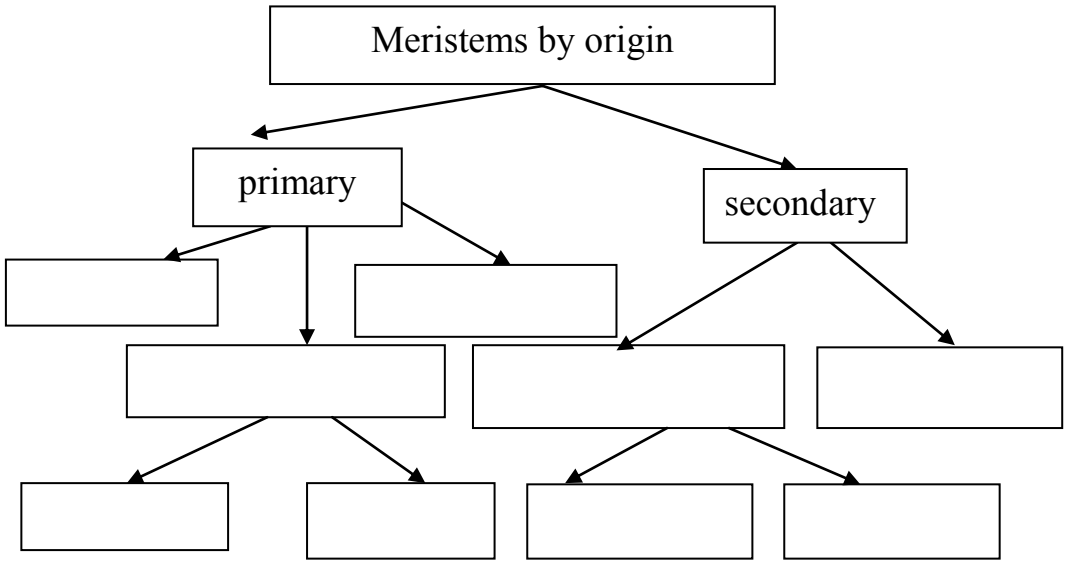
6. List of plant structures that perform external secretory function.	
7. Some of plants accumulate a secret (oils, resins, mucus, etc.) in specialized secretory cells located singly among the main mass of the cells. Name these cells.	
8. What is the secret produce and retain osmophore?	
9. Where are hydatode on the plant?	
10. What is latex?	

Task 2. Choose the correct answer in tests.

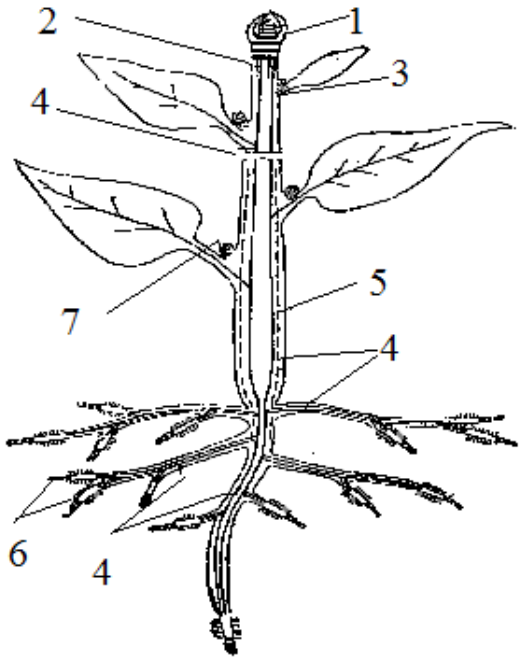
1. Specify the department of plant which is characterized by a secondary meristem – cambium.	A. horsetail B. moss C. coniferous D. ferns E. angiosperms.
2. During the study permanent specimens of shoot apex revealed ..... meristem.	A. traumatic B. laterally C. intercalary D. lateral E. apical.
3. In places of damage plant formed ... meristem	A. generating B. covering C. traumatic D. ateral E. intercalary.
4. As part of perianth found specialized formation as a cilia – osmophore that belong to excretory tissue structures. What substances are they produce?	A. water B. essential oils C. balm D. pitches E. rubber.
5. In which plant organs are found apical tissue?	A. root B. stem C. leaf D. flower E. fruit.
6. On the buds scales and young leaves of the plant contain formation excretory tissue,	A. osmopfores B. hydatode

producing a mixture of terpenes and mucus, and after bud revealed - wither. These formation are called:	C. water stomata D. adhesive hairs E. nectaries.
7. To the list of formations of excretory tissue external secretion accidentally got a structure that performs the function of internal secretion. Specify it:	A. osmophor B. the cell-idiobla C. hydatode D. nectaries A. adhesive hair.
8. At the tips of the leaves cloves located the formation of secretory tissues that provide guttation phenomenon. Name these formations.	A. osmophores B. stomata C. cells idioblasty D. secretory tubules E. hydatodes.
9. The growth of the axial organs to the thickness of leads to activity...	A. apical meristems B. traumatic meristem C. lateral meristem D. intercalar meristem E. peripheral meristem.
10. Select from these meristems those who belong to the secondary.	A. apical B. cambium C. procambium D. pericycle E. phellogen.

Task 3. Enter to scheme the name of primary and secondary meristems (origin).



Task 4. Sign the types of primary and secondary meristems, which numbered in the picture.



Pic. 9. Scheme of placing primary and secondary meristems in dicot plants [15]:

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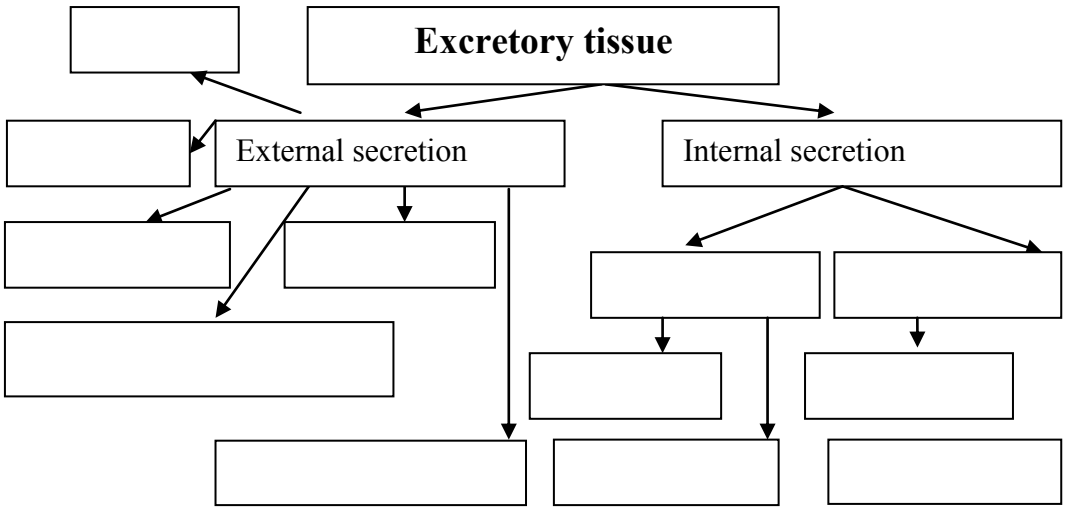
2 – _____
3 – _____
4 – _____
5 – _____

Task 5. Enter to scheme the name of the excretory tissue of external and internal secretion.



Signature of teacher _____

Topic 5.
Parenchyma tissue.

I. Actuality of the topic.

The basic tissue occupies plots between other permanent tissues. They are present in all vegetative and reproductive organs. The cells of these tissues is low differentiated in comparison to other tissues, some of them retains meristematic activity.

There are several varieties of the basic tissue «classical» parenchyma, assimilation, storing, aquifers, pneumatic, each of which performs important functions.

The presence and location in the plants of varieties the basic tissue is diagnostic feature, so the knowledge of their structure, location and functions is necessary in a course «Pharmaceutical Botany» and provides the basis for further study and identification of pharmacognosy of medicinal plants.

II. Learning Objectives:

To:

- know the main characteristics of tissues
- specify the location of ground tissue in the stems, leaves, fruit pulp
- characterize assimilation, storing, and respiratory parenchyma aquifer
- identify the main features of each type of tissue
- compare anatomical features of different types of ground tissue
- give examples of plants with advanced airway and parenchyma aquifer.

Task 1. Answer the questions.

1. Give definition of parenchyma tissue.	
2. Give the classification of parenchyma tissue.	

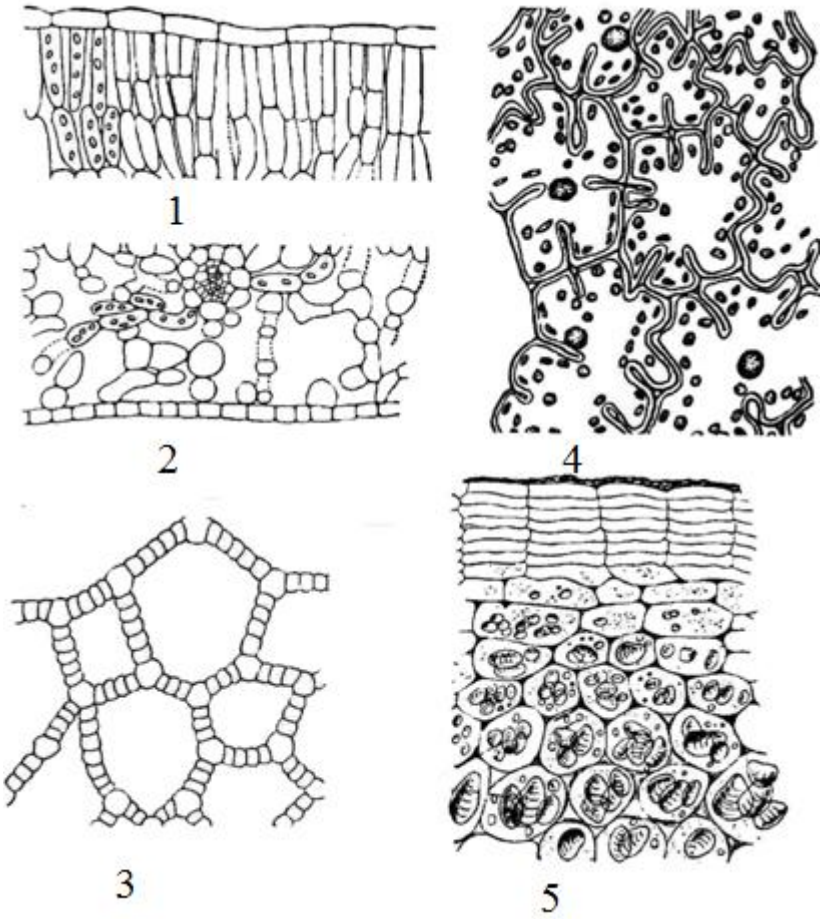
3. Describe the shape, the cell membrane, the cytoplasm of cells parenchyma tissues.	
4. Where is the assimilation tissue in plants? (Give examples).	
5. What is the difference between collenchyma and parenchyma?	
6. What are the features of the structure, location and function of storing parenchyma?	
7. Give examples of plants with developed water-bearing tissue.	
8. What do you know a plant with well-developed aerenchyma?	
9. Which tissue the leaves and stems of aquatic plants are able to refrain and move on the surface of the water?	
10. Give similarities between parenchyma and collenchyma.	

Task 2. Choose the correct answer in tests.

1. Which of these plant tissue types most closely corresponds to the «typical» unspecialized plant cell?	A. xylem B. phloem C. collenchyma D. sclerenchyma E. parenchyma.
2. The basic tissue cells which are capable of photosynthesis, called ...	A. storage B. assimilation C. aerenchyma D. water storage E. pneumatic.
3. Assimilation tissue is located mainly ...	A. in the core of the stem B. under the cork C. surrounding the central cylinder D. phloem and xylem between E. under the epidermis.
4. Most of the chlorenchyma is concentrated in ...	A. leaves B. stems C. roots D. seeds. E. fruits
5. Assimilating parenchyma of leafs mesophillous, which consists of rectangular closely spaced layers of cells with many chloroplasts, called ...	A. spongy B. aerenchyma C. palisade D. pneumatic A. storage
6. Assimilating parenchyma of mesophillous leaf composed of polygonal cells, well defined intercellular spaces and contains a small amount of chloroplasts, called ...	A. spongy B. aerenchyma C. palisade D. pneumatic E. storage.
7. From the list, select such plants that have well-developed water storage parenchyma	A. Cactus B. Agave C. Aloe D. Peanuts E. Almonds.
8. Parenchyma is a type of	A. complex tissue B. simple tissue C. xylem D. phloem.
9. The main function of assimilative	A. photosynthesis

parenchyma is ...	B. transpiration C. gas exchange D. bold products of metabolism E. transport of substances.
10. What are the functions inherent for spongy parenchyma?	A. photosynthesis B. transpiration C. gas exchange D. bold products of metabolism E. transport of substances.

Task 3. Sign the types of ground tissue represented in figures.



Pic. 10. The types of ground tissue [12].

1 – _____
2 – _____
3 – _____
4 – _____
5 – _____

Signature of teacher _____

Topic 6.
Morphology and modification of the root.

I. Actuality of the topic.

Vegetative organs of plants have wide potential for modification which illustrates their adaptive plasticity, based on its multifunctionality. Continued specialization and multifunctionality of the root have caused significant, genetically fixed changes its structure-metamorphosis.

Roots metamorphosis are root crops and root tuber, stem-storage rootable to store various substances that influence human health. They are used in food as well as medicinal herbs.

Therefore, knowledge of anatomy, morphology, chemical composition of the root's modifications is important for students of the Faculty of Pharmacy.

II. Learning Objectives:

To:

- know the terminology: metamorphosis, storage root, root tuber, stem-storage root, root cones, supporting, stilted roots, breathing root, haustorium, mycorhiza, bacteriorhiza.
- characterize modification of roots.
- distinguish between separate modification of roots.
- explain the individual variations roots.
- master the peculiarities of the chemical composition of variations roots different plants.
- give examples of plants that have modification of roots.
- be able to give examples of plan which roots modification of which are used as medicinal plants.

Task 1. Answer the questions.

1. Name the changes the root that can be considered metamorphosis.	
2. Name the root metamorphosis that perform storing function.	
3. List the modification of the root that help a plant better fixed and refrain.	
4. Give examples of plants with different roots modifications.	
5. What is the difference between the root crop and root-tuber?	

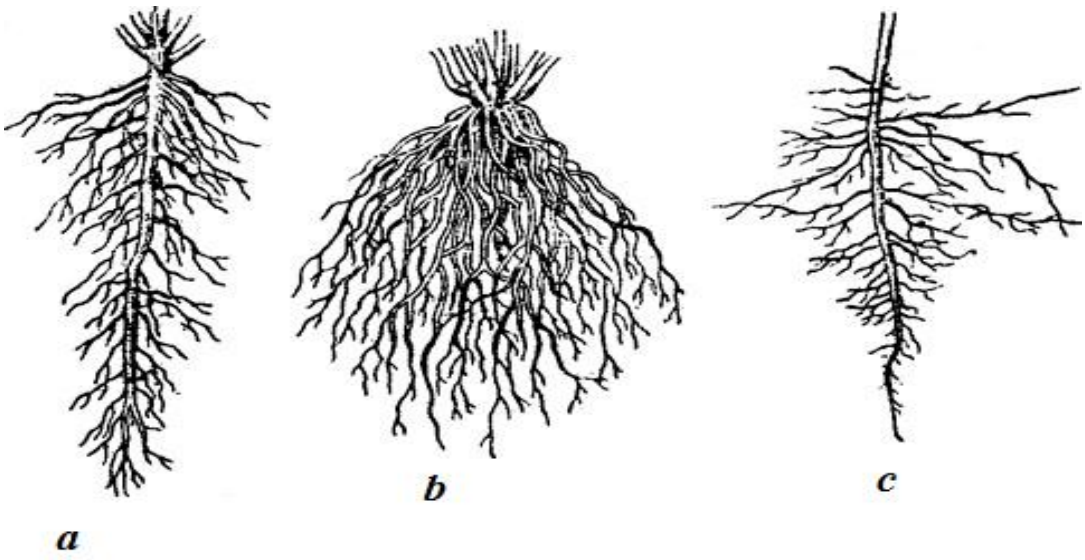
6. What is the prop roots?	
7. What is the aerial root?	
8. What is the mycorrhiza?	
9. What is the bacteriorrhiza?	
10.Can metamorphoses of root be used in medicine and how?	

Task 2. Choose the correct answer in tests.

1. In saffron, lilies, some species of primroses formed roots with the presence of circular cross scales in the parenchyma of the cortex. These roots are able to shrink, so the aerial part of the plant is pressed against the ground. These roots ...	A. supporting B. hapteron C. contractile D. buttress E. haustoria.
2. Crown some tropical trees reach a thousand or more square meters. This is possible due to special roots that grow down from branches and then root. These roots are called ...	A. supporting B. buttress C. contractile D. hapteron E. gaustoria.
3. Ivy has a climbing stem that is fixed on the walls and tree trunks through ...	A. moustache. B. antennae C. scourge D. hapteron E. haustoria.
4. Often the roots of pine issued entwined hyphas mushrooms. This phenomenon is called	A. endomycorrhiza B. micobiont C. exomycorrhiza D. gummozis E. guttation

5. From the following list of plants select the folderthat characterized endotrophic mycorrhiza	A. Clover B. Oak C. Lime D. Birch E. Aspen.
6. From the following list of plants select the folderthat characterized ekzotrophic mycorrhiza	A. Orchid B. Irises C. Sweet clover D. Strawberries E. Hazel.
7. Plant parasites and semiparasite are inherent roots that penetrate and develop in the tissues of plants-owner. These roots are called ...	A. supporting B. buttress C. contractile D. hapteron E. haustoria.
8. Among the listed plants, choose a folder, which is characterized by the presence of haustoria …	B. Irises C. Clover D. Peter cross E. Onions F. Sweet clover.
9. Air roots of philodendron covered with multi-layered fabric that absorbs moisture from the air through the capillary. This tissue ….	A. cuticle B. libriform C. velamen D. ectoderm E. intine.
10. With thickening of additional or lateral roots, and sometimes certain parts of the stem (sweet potatoes, dahlias) or stem buds (buds) is formed ...	A. root crop B. stem's tuber C. root cones D. tubers E. food-storage root.

Task 3. Sign the types of root systems, which numbered in the picture.



Pic. 11. Types of the root systems [26]:

a – _____

b – _____

c – _____

Task 4. Specify the metamorphosis of roots, marked with letters in the picture to give examples of plants which are typical.

Pic. 12. Metamorphosis of the root [21]:

A – _____
B – _____
C – _____
D – _____
E – _____
F – _____
G – _____
H – _____
I – _____

Signature of teacher _____

Topic 7.
Morphology and modification of shoot.

I. Actuality of the topic.

Formation of metamorphosis and specialization of plant's organs connected with the long historical development of latter and have adaptive character to survive in different environmental conditions. Metamorphosis and specialization may include all shoot or separately one of its parts. As for the stem - as part of the shoot, we distinguish its aerial and ground modification. The study of the questions about origin, anatomical structure, morphology, chemical composition of metamorphosis is of great interest for the students of the Faculty of Pharmacy because bulbs, tubers, rhizomes and other modifications stems are used as medicinal plants.

II. Learning Objectives:

To:

- know the terminology: aerial stolons, mustache, whips, antennae, stem tubers, tubers, areola, cladode, filocladode, tubers, bulbs, corms, caudex, rhizome, an underground stolon.
- characterize some modification of modification of stems.
- distinguish individual modification of stems.
- explain the individual modification stem
- master the peculiarities of chemical composition modification stems of various plants.
- give examples plants that have modification of stems.
- be able to give examples of plant modification of stems, which are used as medicinal plants.

Task 1. Answer the questions.

1. What is the difference between similar metamorphosis and homologous organs?	
2. What modification of shoots is belong to the above-ground?	

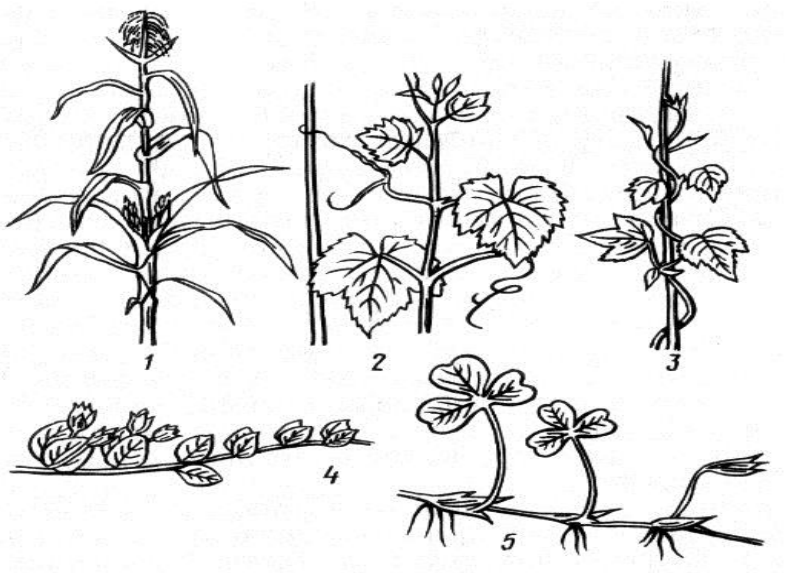
3. Explain the difference between mustache and tendrils (provide examples).	
4. What is the function of the thorn?	
5. What is the difference between phyllode and phylloclade?	
6. Name the modification of underground shoots.	
7. What are the rhizome by the place of formation, by the direction of growth, by type of growth?	
8. Name the examples of plants which have underground organ are tubers.	
9. What is the difference berween the simple bulb and complex?	
10. Name the plants, bulbs and rhizome which are used in pharmacy and medicine.	

Task 2. Choose the correct answer in tests.

1. Metamorphoses, which have different origins, but similar in structure and function, called ...	A. homologous B. somatic C. reproductive D. generating E. analogous.
2. Metamorphoses that have the same origin, but differ morphologically and functionally, called ...	A. homologous B. somatic C. reproductive D. generating E. analogous.
3. Modification with elongated internodes, creeping shoots of strawberries that are able to root it is ...	A. spur B. cladode C. runners D. phylloclade E. tendril.
4. Modification threadlike or like spiral shoot of pea, ensuring its attachment to the support, are ...	A. spur B. cladode C. runner D. phylloclade E. tendril.
5. A cactus has warty shortened side shoots with bunches of thorns. This is the ...	A. phyllode B. areola C. phylloclade D. tendril. E. spur.
6. Reclining stems of the pumpkin rooting at the nodes. These stems are called ...	A. phyllode B. areola C. phylloclade D. tendril E. scourge.
7. From the list select the plants that has a rhizome.	A. *Valeriana officinalis* B. *Lilium martagon* C. *Galanthus nivalis* D. *Helianthus tuberosus* E. *Cyclamen.*
8. At the core of the bulbs is shoot with hard, shortened, simplified or tapered stem, called ...	A. callus B. fundus C. caudex D. hypocotyl E. prothallium.
9. The tubers of some plants which	A. *Batat*

are used in a food as a source of nutrients. Choose plant tubers which are rich in inulin.	B. *Dioscorea rotundata* C. *Helianthus tuberosus* D. *Solanum tuberosum (potato)* E. *Dioscorea caucasica.*
10. From the following list select the plants that has abulbotuber.	A. *Galanthus nivalis* B. *Cyclamen.* C. *Drimia maritima* D. *Allium caepa* E. *Colchicum.*

Task 3. Sign the types of stems, depending on their location in space.



Pic. 13. Types of stem depending on its position in space [18]:

1 – _____

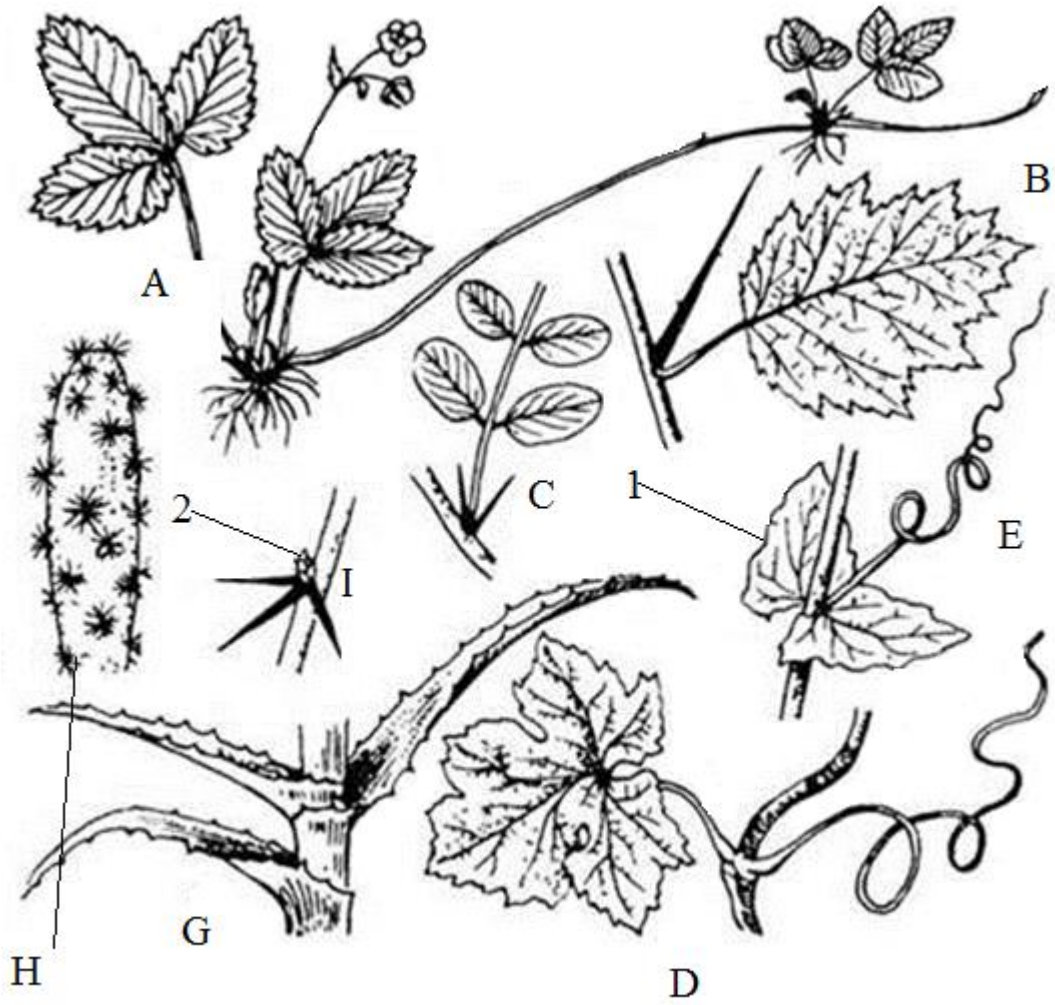
2 – _____

3 – _____

4 – _____

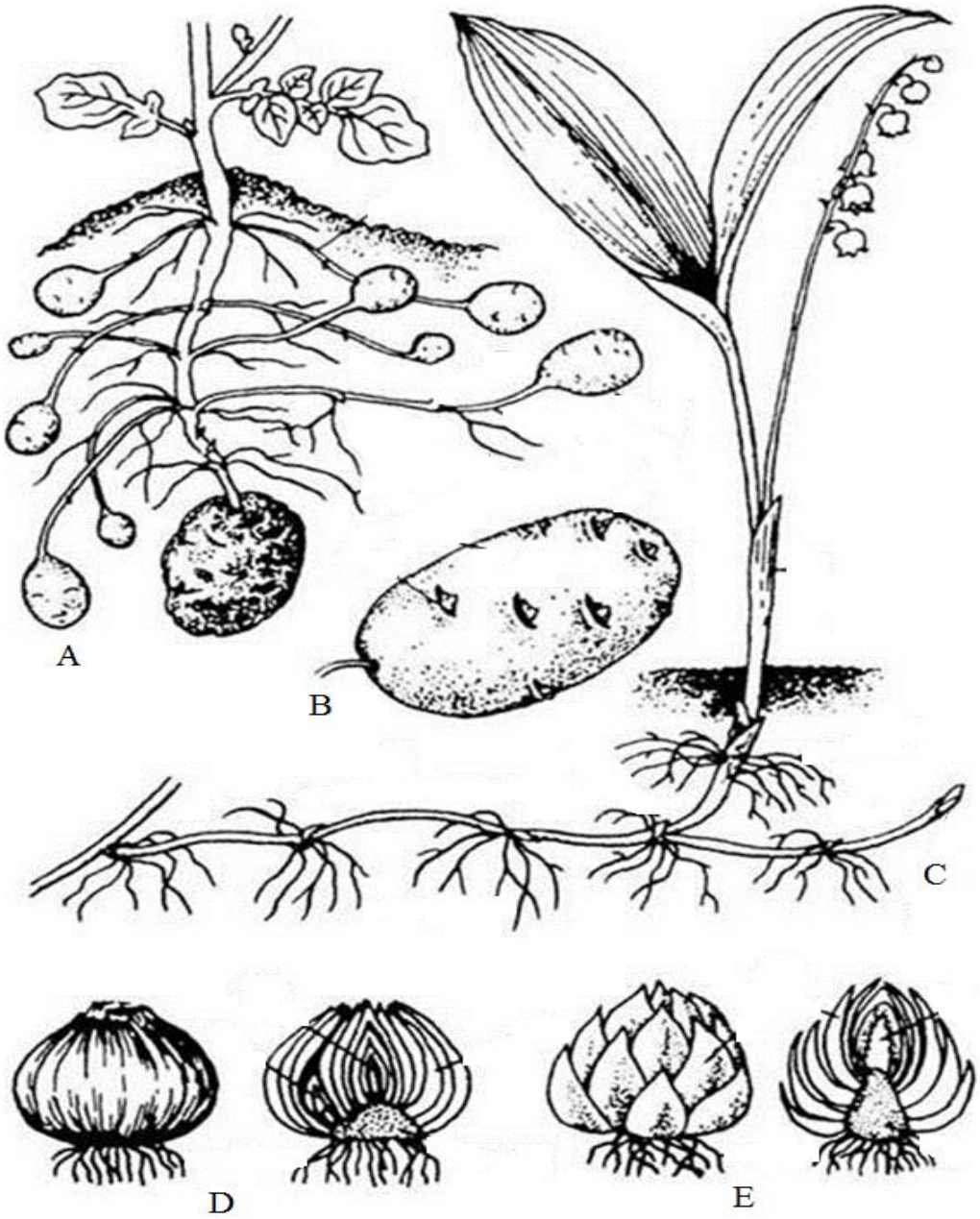
5 – _____

Task 4. Specify the above-ground (I) and underground (II) the metamorphosis of shoots, denoted by letters in the picture to give examples of plants which are typical.



Pic. 14. Modification of the above-ground shoot [18]:

A – _____
B – _____
C – _____
D – _____
E – _____
G – _____
H – _____
I – _____
1 – _____
2 – _____



Pic. 15. Modification of underground shoots [23]:
A – _____
B – _____
C – _____
D – _____
E – _____

Signature of teacher _____

Topic 8.
Morphology and modification of leaf.

I. Actuality of the topic.

Leaf is the most plastic organ of the plant that subtly reacts to changes of environmental conditions. External manifestation of the plant response to changing of these conditions are the anatomical and structural restructuring of organ.

So, aloe leaves have well developed water forming parenchyma, in pea leaf metamorphosis plate caused the formation of tendrils, through which the plant clings for each other and did not lodge; quite unique metamorphosis of leaves formed in insectivorous plants; original morphological and anatomical structure has needles and etc.

Features of the leaf's modifications is primarily diagnostic signs of families and species features, knowledge of which are necessary in the study of botany.

In addition, modified leaves of different plants (aloe, pine) are used as medicinal herbsand the same study features of their structure and chemical composition is important for the further mastery of disciplines such as pharmacognosy and others.

II. Learning Objectives:

To:

- distinguish metamorphosis of leaves.
- distinguish tendrils and thorns of stem's and leaf's origin.
- identify the structural features of leaves of aquatic plants and plants arid areas.
- explain the morphological and anatomical features leaves of conifers.
- direct features of leaves monocotyledonous plants.
- know the chemical composition of leaves modified that used as medicinal.
- explain the importance of the phenomenon.
- describe the metamorphosis of leaves of insectivorous plants (trapping devices)
- be able to give examples of plants with different types of leaf metamorphosis.

Task 1. Answer the questions.

1. Name the metamorphosis of leaves and examples of plants.	

2. Explain the difference between phyllode and phylloides.	
3. What plants are belong to succulents? Give examples.	
4. What is the phenomenon of heterophylly?	
5. What needles are characterized from morphological and anatomical point of view?	
6. Name the features of plant leaves arid areas.	
7. What is different anatomy of leaves of aquatic plants?	

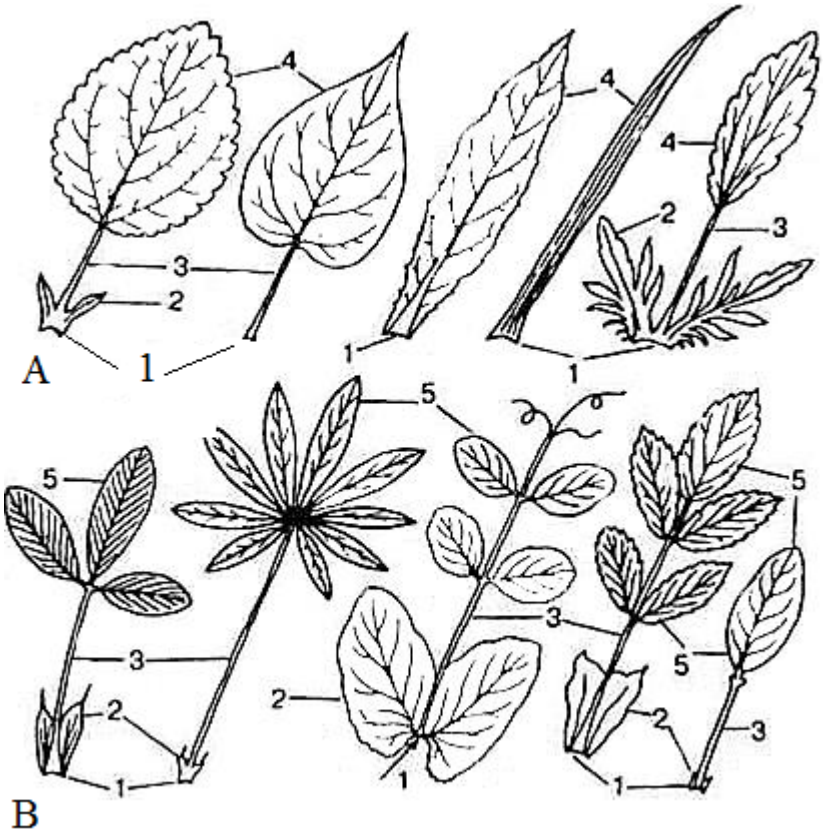
8. Give examples of insectivorous plants which have modified leaves.	
9. What are the features of leaves of cereal plants??	
10. Give examples of medicinal plants that are modified leaves. For what purpose they are used in medicine and pharmacy?	

Task 2. Choose the correct answer in tests.

1. From the following metamorphosis of plants, choose one that's a variation of leaf.	A. tendrils B. cladode C. phylloclade D. caudex E. whip.
2. The petiole of modified leaf of Australian acacia is leaf-like expanded and performs the function of leaf plate. Adaptation is aimed at reducing transpiration. This formation is	A. cladode B. phyllode C. phylloides D. phylloclade E. caudex.
3. A thalloms and mosses do not have true leaves. Their functions are performed like-leaves formation ….	A. cladode B. phyllode C. phylloides D. phylloclade E. caudex.
4. Among the following characteristics conifers of leaves, choose one that is not typical of them:	A. the needle-like form B. have a thick epidermis with cuticle C. have folded parenchyma D. many stomata are located on the surface E. presence resin channel.
5. Determine which of these signs is	A. narrow-lanceolata form of leaf

not found in the leaves of cereal plants:	plate B. developed epidermis C. clearly defined two types of assimilation parenchyma – palisade and spongy D. well developed mechanical tissue E. stomata are located in regular rows of epidermis.
6. What is the feature of the leaf's structure from the following leaves of plants not typical for the arid areas?	A. developed mechanical tissue B. many stomata C. available waxy coating D. hairline cover E. narrow leaf plate.
7. Name the feature of the leaf structure of the underwater (submersed) plants:	A. stomata is absent B. developed aerenchyma C. well developed phloem D. weakly developed xylem E. small number vascular bundles.
8. The epidermal cells of water plants with small plastids and a high degree of permeability membranes, called ...	A. hydatodes B. torus C. thylakoids D. initial E. hydropotes.
9. The modified leaves of plants that grow in arid areas have developed water-storage parenchyma from which thick, juicy. These plants belong ...	A. *Frangula alnus* B. *Nuphar lutea* C. *Arctium lappa* D. *Aloe arborescens* E. *Vinca minor.*
10. Name a plant which leaves are modified in catching devices.	A. *Silybum marianum* B. *Potentilla* C. *Artemisia* D. *Amaryllis* E. *Nepenthes.*

Task 3. Specify simple and compound leaves, and mark them as individual items.



Pic. 16. Simple ……and compound ……leaves [24]:

1 – _____

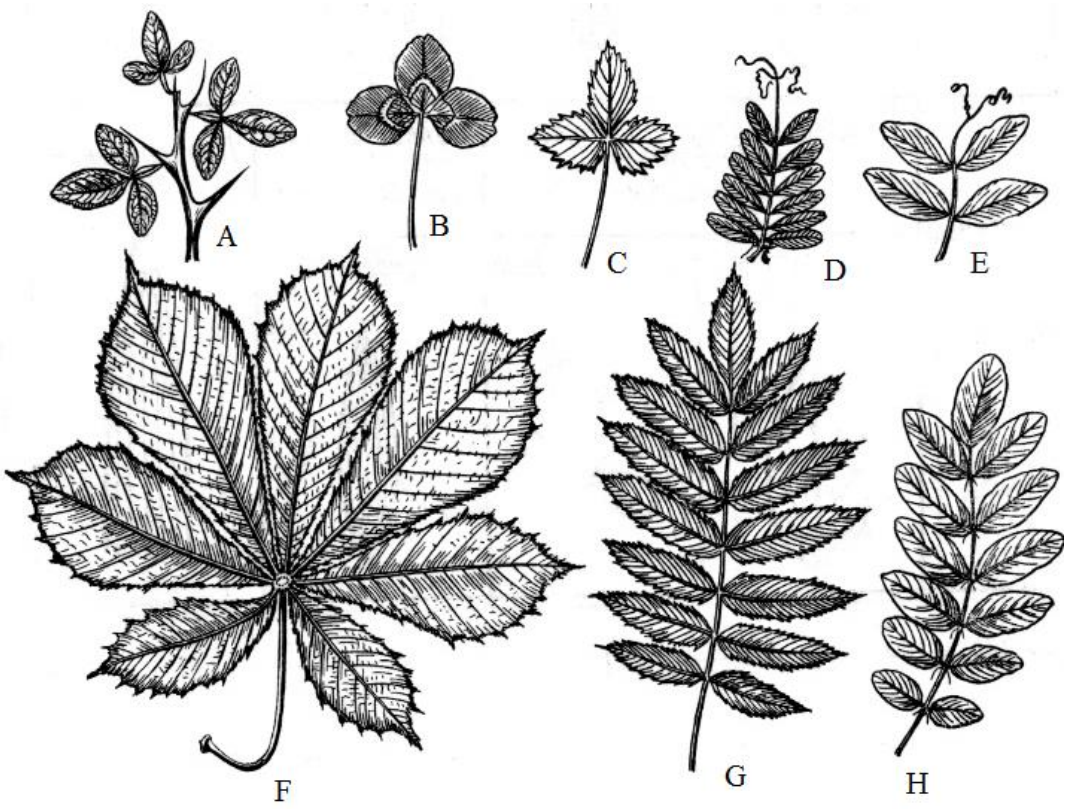
2 – _____

3 – _____

4 – _____

5 – _____

Task 4. Specify the complex leaves.



Pic. 17. Compound leaves [19]:

A – _____

B – _____

C – _____

D – _____

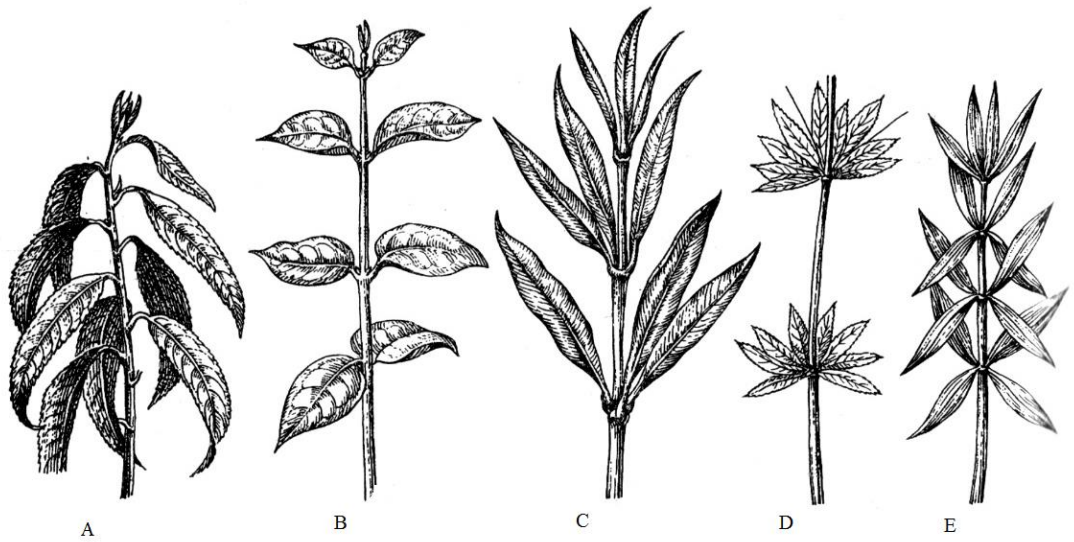
E – _____

F – _____

G – _____

H – _____

Task 5. Specify the types of leaf arrangement.



Pic. 18. Leaf arrangement [20]:
A – _____
B – _____
C – _____
D – _____
E – _____

Signature of teacher _____

Topic 9.
Pollination and fertilization in plants.

I. Actuality of the topic.

Pollination is the process of transferring pollen from stamens to stigmas of the pistils inherent seeds.

Fertilization is the process of fusion of gametes.

Reproduction is a reproduction of such individuals is one of the fundamental properties of living that provides safety, continuity of the species and increase its size. Humans widely use this property to plant at the farm, crop, agriculture industry, biotechnology and so on. Natural and artificial methods of reproduction plant organisms are the basis obtain biomass, metabolic products, food. Special accent in the course of pharmaceutical botany placed on the importance different methods of organisms in plant reproduction detention of medicinal plantsand the same the knowledge of the issue is necessary for the students of of the Faculty of Pharmacy.

II. Learning Objectives:

To:

- know definitions of the different methods of plant's pollination: self-pollination, cross pollination; natural and artificial.
- explain the biological significance of different ways of pollination.
- know the terminology: spores, zoospores, aplanospory, isogamy, heterogamy, oogamy, gametangeogamy, zygogamy, somatogamy, antherid, archegonium, gametophyte, sporophyte, nuclear phase, alternation of generations, particulation, sormentation, diaspore, sprig, ingrafting, cleft-graft scion, stock, copulation, inoculation.
- direct the differences of sexual, asexual, vegetative ways of reproduction.
- explain the essence of different ways of plants reproduction.
- understand the importance of each way of reproduction.
- To characterize the full life cycle of higher plants.
- compare the essence of sexual and unsexual phase of plant development.
- distinguish the principles varieties of natural vegetative reproduction.
- understand essence of ingrafting as a form of artificial for vegetative reproduction.
- give examples of methods of plant selection.

Task 1. Answer the questions.

1. What is the essence of unsexual reproduction?	
2. What is the difference between vegetative reproduction and unsexual?	
3. Explain the essence and importance of sexual reproduction.	
4. What phases are include to full life cycle development of higher plants?	

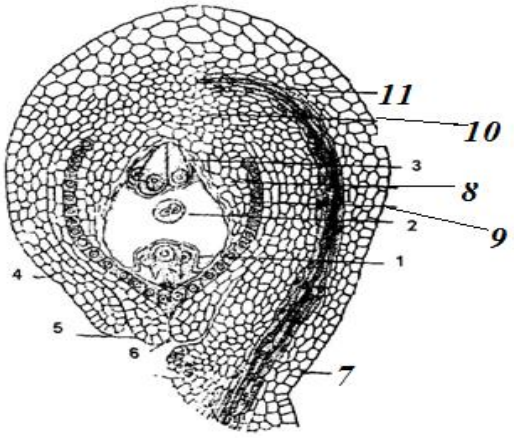
5. What kind of cross-pollination do you know?	
6. Give examples of plants that have self-pollination.	
7. Explain the essence of particulation, sormantation, diasporation	
8. During double fertilization by the merger of one of the central sperm cell diploid embryo sac is formed ...	
9. Name the scientist who discovered and described the double fertilization in flowering plant	
10. What is the structure of the embryo sac formed by the merger of sperm and egg?	

Task 2. Choose the correct answer in tests.

1. The sexual process in plants and fungi, based on the merger of two mobile and morphologically identical gametes, called ...	A. isogamy B. heterogamy C. oogamy D. gametangeogamy E. zygogamy F. somatogamy.
2. What is the name of the type of sexual process in plants in which copulate gametes which differ in shape, size and physiological features?	A. isogamy B. heterogamy C. oogamy D. gametangeogamy E. zygogamy.
3. In what plant organs are ripen male gametes?	A. strobilus B. antherid C. microsporangium D. archegonium E. sclerotia.
4. In what plant organs are ripen female gametes?	A. strobilus B. antherid C. microsporangium D. archegonium E. sclerotia.

5. One of the following methods of vegetative reproduction of plants do not belong to the number of artificial. This is the ….	A. copulate B. particulation C. inoculation D. ingrafting E. hybridization.
6. From the following list of plants, select the folder which is characterized anemophily.	A. *Triticum* B. *Helianthus* C. *Robinia* D. *Solanum tuberosum* E. *Fagopyrum.*
7. The gemmiferous germs or fragments of mature vegetative organs, which are separated from the mother's body and able to germinate into a new plant, called ..	A. zoospores B. aplanospores C. ascospores D. basidiospore E. diaspora.
8. Entomophily is a process of plants pollination involving the ...	A. insects B. wind C. birds D. waters E. mammals.
9. One of the following methods of vegetative reproduction is not among the natural. This is the ….	A. sormentation B. diasporation C. cutting D. particulation E. false viviparity.
10. In fungi during sexual process merges the contents of two single- or multinuclear cells of mycelium are not differentiated gametes. This process is called ...	A. isogamy B. heterogamy C. oogamy D. gametangeogamy E. zygogamy F. somatogamy.

Task 3. Sign the names of the structures numbered in the figure.



Pic. 19. Cross-cut seed germ [11]:
1 – _____
2 – _____
3 – _____
4 – _____
5 – _____
6 – _____
7 – _____
8 – _____
9 – _____
10 – _____
11 – _____

Signature of teacher _____

Topic 10.
The structure of the seed. Distribution of fruits and seeds.

I. Actuality of the topic.

Seed is the embryonic stage of seed plants that develops from a germ seed; main organ of reproduction and settlement holo- and angiosperms. The appearance of the seed is the a new stage in the evolution of plant life compared to the spore, because the seed are adequate supply of nutrients, well differentiated embryo, and solid protection in the form of seed skin, allowing for a long time to keep seed germination.

Seeds of many plants are rich in fat and essential oils, carotenoids, vitamins, proteins, carbohydrates, volatile alkaloids, coumarin, organic acids, that are valuable human food. Seeds of many plants used in pharmacy as a medicinal plant.

The knowledge of morphology and anatomical features of the seed (shape, size, color), histological characteristics of individual parts are the basis of a systematic group as are the diagnostic criteria. In addition, it is necessary for accurate identification of medicinal raw materials and quality.

II. Learning Objectives:

To:

- know the terminology: micropyle, funiculus, spermoderm, perisperm; stratification, scarification;
- know the seeds structure of monocots and dicots.
- know classification seeds by the presence of extraembryonic storage tissues and the composition of storage nutrients.
- know the meaning and biological role of seed.
- know to recognize the structure of seed in micropreparates.
- know to compare the structure of monocots and dicots plants.
- give examples of plants whose seeds used as a medicinal plant.
- explain the biological role of fruit and seeds.
- compare seeds structure of monocots and dicots.
- be able to give examples of plants whose seeds used as herbal drugs.
- prove the value of using seeds in pharmacy, medicine.

Task 1. Answer the questions.

1. When seeds are formed?	
2. The composition of seed includes such structures ...	
3. How much cotyledons are contain seeds of pea?	
4. What tissue is develop after the merger of sperm and central diploid cells in the embryo sac?	
5. Which of nutritional and bioactive substances are deposited in the fruits, the seeds?	

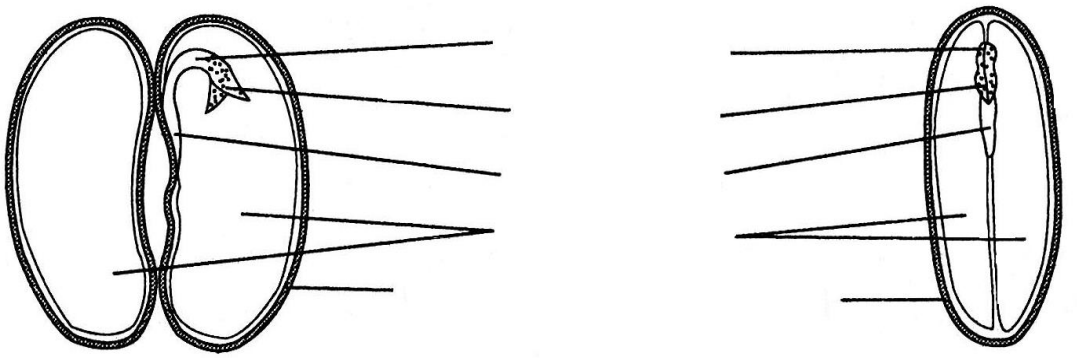
6. Name the different structure of seeds gymnosperms, monocots and dicots plants.	
7. Name the main organ of reproduction and distribution of gymnosperms and angiosperms.	
8. Explain the terms anemochry, zoochory, anthropochory, autochory.	
9. Name the methods of breach seed dormancy.	
10. Give examples of using seeds in pharmacy and medicine.	

Task 2. Choose the correct answer in tests.

1. The structure of each seed flowering plants include: seed coat, germ and spare nutrients. From what does develop embryo of seeds?	A. from nucellus B. from ovary C. from zygote D. from seed bud E. from the embryo sac.
2. Choose fruit that as described: coenocarpous fruit with glandular exocarp, spongy mesocarp and juicy effused endocarp.	A. pod B. hesperidium C. caryopsis D. capsule E. nuts.
3. As a result of double fertilization remains of nucellus of seeds germ turned into a nutritious tissue ...	A. endosperm B. scleroderma C. chlorenchyma D. parenchyma E. perisperm.
4. Choose fruit that as described: the fruit is pseudomonocarp with lignified pericarp and one seed (rarely two seeds,	A. pod B. acorn C. caryopsis

the skin of which is not fused with pericarp).	D. capsule E. nuts.
5. Choose fruit that as described: coenocarpous fruit whose mesocarp formed from hypanthium tissue.	A. capsule B. pod C. apple D. berry E. acorn.
6. Choose fruit that as described: fruit apocarpous with lignified pericarp that does not fuse with the seed skin.	A. complex drupe B. complex stone fruit C. nutlet D. apple E. pod.
7. Fruit of rowan defined as false coenocarpous, because his leathery exocarp and juicy mesocarp formed from hypanthium and the seed surrounding by gravely endocarp that formed by the lower wall of the ovary. So, this fruit is …	A. complex drupe B. complex stone fruit C. nutlet D. apple E. pod.
8. Follicule developed from single-carpel ovary, splits open down one side. These include:	A. Columbines B. Milkweed C. Elms D. Cotton E. Walnut.
9. Fleshy fruits include:	A. berry B. nut C. capsule D. drupe E. pepo.
10. Multiple fruits include:	A. fig B. apple C. strawberry D. pineapple E. mulberry.

Task 3. Sign the names of the structures numbered in the figure.



Pic. 20. The scheme of the structure of Bean seeds [27].

Signature of teacher _____

PART II. MODULE II.
«BASICS OF TAXONOMY, PHYTOECOLOGY AND GEOBOTANY»

Practical lesson 1.

Topic: Characteristic of Highest Spore-bearing Plants.

Goals and objectives: to study the terminology: sporophyte, gametophyte, archegonia, antheridia, phyllodes, protonaema, kaliptra, ryzophores, sporanghiofors, strobils, sorus, induzium, vayyas, sporohon, micro-and makrospores, elateries; the main difference of body structure between Mosses, Lycopsids, Horsetails and Pteridophytes; the constitution of vegetative body's primitive structure of mosses and other progressive higher spore plants; which parts of various higher spore plants are used in medical preparations; the list of poisonous higher spore plants, and those listed in the Red Book of Ukraine. To: give a classification of higher spore plants; explain the flow of life cycles of higher spore plants of different departments using tabular material; different representatives of various departments at higher spore herbarium specimens and to characterize the morphological characteristics of their bodies (horsetail,etc.); identify the organs of higher spore plants using herbarium sample; explain what biologically active substances cause action of drugs derived from medicinal higher spore plants; analyze specimens of higher spore plants, such section of the stem of horsetail.

Workflow

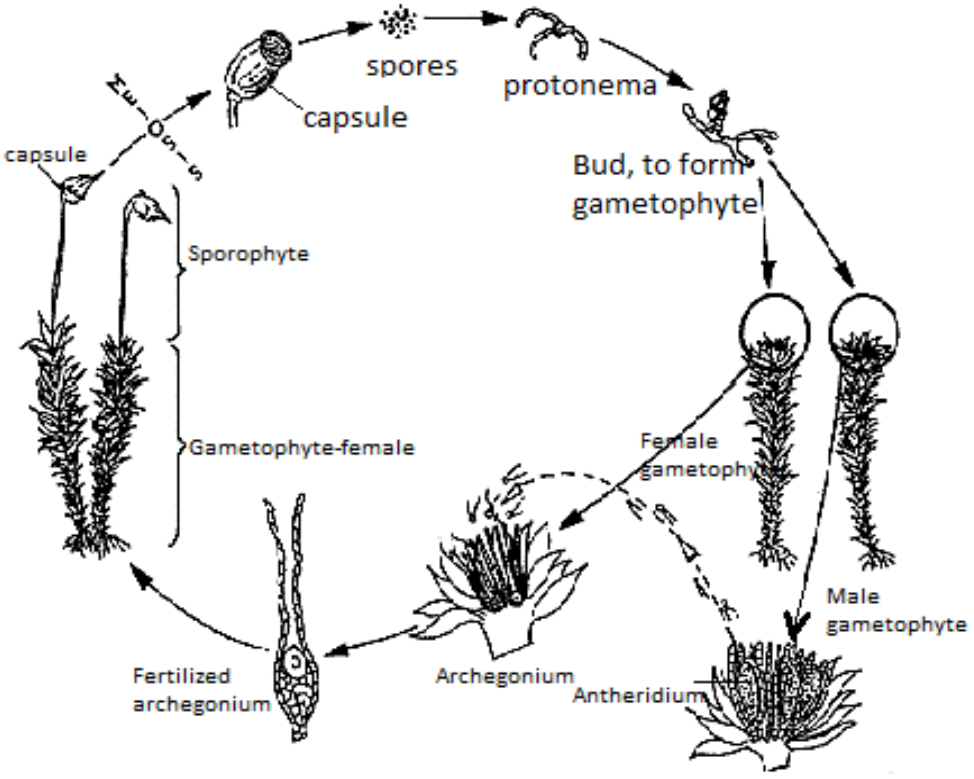
1. Cross-section of the stem of Polytrichum commune (permanent specimens).

Using low magnification microscope examine the cross-section of the flax stem. Note that there is the concentric conductive beam in the centre of the stem, which is composed of elongated cells similar to tracheids and tubes. It is surrounded by parenchyma, which also provides conductive function. Parenchymal tissue is surrounded by sclerenchyma . Outer layer of scleroderma, which consists of colorless cells, is called gyaloderma.

Picture the cross section of the stem of the flax and mark xylema, phloema, parenchyma, skleroderma, hialoderma.

2. Diagram of the life cycle Polytrichum commune.

Using tables and herbarium samples, make a diagram of the life cycle of the flax and show its main development stages.



Pic. 21. The life cycle *Polytrichum* [28].

3. Longitudinal cut through the spore-holding ear of Lycopodium clavatum (permanent specimens).

Using low magnification microscope examine the cross-section of the spore-holding ear of *Lycopodium clavatum*. Locate string-like sporangias, sitting on short legs. Note that each sporangium is filled with the same, small, tetrahedral spores.

Picture the fragment of sample, mark spores and sporangia.

4. Morphological description of Equisetum arvense (by herbarium speciment).

Carefully examine the herbarium sample of horsetail and make its morphological description as given in the scheme below.

Stems:

• Spore-holding are same as vegetative; spore-holding are different from vegetative (specify what)

• Appearance – simultaneous; spore-holding appear before the vegetative (or vice versa)

• Life expectancy – annuals, perennials

Leaves:

• Form – axil, cylindrical, conic or reverse-conic

• The number of leaf teeth (please specify)

• Growth of leaf teeth – welded, free

• Shape of leaf teeth – pointy, blunt, etc.

Spore-holding ear:

• Top – sharp, blunt.

• Number of sporangiephores (please specify)

• The number of sporangia.

Signature of teacher _____

Practical lesson 2.

Topic: Pinophyta or Gymnospermae Division Classes Cycadopsida, Ginkgopsida, Gnetopsida. Morphological and anatomical features of Pinophyta division representatives. Characteristics and medical importance of Pinopsida class representatives.

Goals and objectives: to study classification of Gymnospermae: class names, families and their representatives in Latin; the Pinopsida Class classification; anatomical and morphological advantages of Gymnospermae that have arisen during evolution compared to higher spore plants; diagnostic features of Pinopsida Class representatives and its families of Pinaceae, Cupressaceae, Taxaceae; the life cycle features of conifers (table); structure and function of male and female cones of conifers (table, macropreparations, herbarium specimens);peculiarities of vegetative and generative organs (table).To be able to: allocate the distinctive features of plants Classes Cycadopsida, Ginkgopsida, Gnetopsida; describe the representatives of each of the classes considered at the lesson (*Ephedra distachya*, *Gingko biloba*) by herbarium specimens, Cycas

revoluta –using a table; give the main characteristic features of conifers; compare the different types of cones mature conifers, particularly Pinaceae Family (*Pinus sylvestris*, *Picea abies*, *Abies alba*, *Larix sibirica*), using specimens and macropreparations; give an examples of medicinal forms and medicinal products derived from medicinal vegetative raw materials of Gymnospermae; distinguish *Ginkgo biloba* leaves by morphological characteristics (herbarium specimens).

Workflow

Morphological description of ***Pinus sylvestris, Picea abies*** (by herbarium specimen).

Carefully consider the herbarium specimens of *Pinus sylvestris, Picea abies,* and make its morphological description by the scheme below.

Plant:

- evergreen, deciduous

Shoot:

- only elongated, but shortened and elongated and shortened

Leaves:

- needle, scarious, with leaf blade
- apex – acute, retuse
- length (cm)
- leaf arrangement – alternate, opposite, whorled, in clusters (please specify the number of leaves in clusters
- *Female cone:*
- the location in space - hanging down, erect (upright on)
- shape-cylindrical, oval, etc.
- fall down - right after rash seeds, three or four years; completely, in parts.
- sterile scales - is or not; consistency - woody, juicy; form (please specify)

Draw a *Pinus sylvestris* branch, and mark male and female cones of 1st, 2nd, 3rd years of life. Write down what from the types above is the medicinal vegetative raw materials and the direction of their use in medicine.

Morphological description of ***Larix sibirica, Ginkgo biloba, Ehpedra distachya*** (by herbarium specimen).

Carefully consider the herbarium specimens of *Larix sibirica, Ginkgo biloba, Ehpedra distachya* and make its morphological description by the scheme below.

Plant:

- evergreen, deciduous

Shoot:

- only elongated, but shortened and elongated and shortened

Leaves:

- needle, scarious, with leaf blade
- apex – acute, retuse
- length (cm)
- leaf arrangement – alternate, opposite, whorled, in clusters (please specify the number of leaves in clusters
- *Female cone:*
- the location in space - hanging down, erect (upright on)
- shape-cylindrical, oval, etc.
- fall down - right after rash seeds, three or four years; completely, in parts.
- sterile scales is or not; consistency - woody, juicy; form (please specify)

Signature of teacher _____

Practical lesson 3.

Topic: Ranunculidae Subclass. The Ranunculaceae Family, the Papaveraceae Family.

Goals and objectives: to study: classification of Ranunculidae Subclass; diagnostic features of Ranunculaceae Family representatives; diagnostic features of Papaveraceae Family representatives; morphological features of Ranunculaceae Family species – *Adonis vernalis*, *Aconitum napellus*, *Delphinium elatum*, *Consolida regalis* (by the herbarium specimens and tables); morphological features of Papaveraceae Family species – *Glaucium flavum*, *Papaver somniferum*, *Chelidonium majus* (by the herbarium specimens and tables);chemical composition of Ranunculidae Subclass species. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Ranunculus acris, Anemona ranunculoides*** (by herbarium specimens)

Carefully study herbarium specimens of ***Ranunculus acris, Anemona ranunculoides*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot* :**

- aerial , underground

- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)

- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

- the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb.

Morphological characteristic of ***Consolida regalis, Aconitum soongoricum,*** (by herbarium specimens)

Carefully study herbarium specimens of ***Consolida regalis, Aconitum soongoricum*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

• Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot* :**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)

- length (cm)

***Stem* :**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)

- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

- the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb.

Morphological characteristic of ***Papaver somniferum, Chelidonium majus*** (by herbarium specimens)

Carefully study herbarium specimens of ***Papaver somniferum, Chelidonium majus*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

• class , subclass, family, genus

***Life form*:**

• Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot* :**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem* :**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils)

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous

- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

- the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb.

Signature of teacher _____

Practical lesson 4.

Topic: Hamamelididae Subclass. The Fagaceae Family, the Betulaceae Family, the Juglandaceae Family. Carryophyllidae Subclass. The Polygonaceae Family.

Goals and objectives: to study: to know: classification of Hamamelididae and Carryophyllidae Subclasses; diagnostic features of Fagaceae, Polygonaceae, Betulaceae, Juglandaceae Families representatives; morphological features of Polygonaceae Family species – Polygonum aviculare, Polygonum hydropiper, *Poligonum bistorta*, *Fagopyrum sagittatum*, *Rheum tanguticum*, *Rumex confertus* (by the herbarium specimens and tables); morphological features of Betulaceae Family species – *Alnus glutinosa*, *Betula verrucosa* (by the herbarium specimens and tables); morphological features of Fagaceae Family species – *Quercus robur* (by the herbarium specimens and tables); chemical composition of Polygonaceae, Betulaceae and Fagaceae Subclasses species. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Quercus robur, Betula verrucosa*** (by herbarium specimens)

Carefully study herbarium specimens of ***Quercus robur, Betula verrucosa*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils)

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

- the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb.

Morphological characteristic of ***Juglans regia, Polygonum aviculare*** (by herbarium specimens)

Carefully study herbarium specimens of ***Juglans regia, Polygonum aviculare*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

• class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground

- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)

- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

- the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb.

Morphological characteristic of ***Polygonum hydropiper, Poligonum persicaria, Rumex confertus*** (by herbarium specimens)

Carefully study herbarium specimens of ***Polygonum hydropiper, Poligonum persicaria, Rumex confertus*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

• class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

- the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb.

Signature of teacher _____

Practical lesson 5.

Topic: Dilleniidae Subclass. The Clusiaceae family, the Ericaceae family, the Brassicaceae Family, the Tilliaceae Family, the Malvaceae Family, the Cannabaceae Family, the Urticaceae Family.

Goals and objectives: to study: classification of Dilleniidae Subclass; diagnostic features of Clusiaceae, Ericaceae, Brassicaceae, Tilliaceae, Malvaceae, Cannabaceae, Urticaceae Families representatives; morphological features of Brassicaceae Family species – *Brassica oleracea*, *Capsella bursa-pastoris*, *Erysimum canescens*, *Sinapis alba*, *Sinapis juncea*, *Sinapis nigra* (by the herbarium specimens and tables); morphological features of Ericaceae Family species – *Arctostaphylos uva-ursi*, *Ledum palustre*, *Oxycoccus palustris*, *Vaccinium myrtillus*, *Vaccinium vitis-idea* (by the herbarium specimens and tables); chemical composition of Clusiaceae, Ericaceae, Brassicaceae, Tilliaceae, Malvaceae, Cannabaceae, Urticaceae Subclasses species. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studiedю

Workflow

Morphological characteristic of ***Hypericum perforatum, Arctostaphylos uva-ursi*** (by herbarium specimens)

Carefully study herbarium specimens of ***Hypericum perforatum, Arctostaphylos uva-ursi*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic of ***Vaccinium vitis-idea*, *Althea officinalis*,** (herbarium specimens)

Carefully study herbarium specimens of ***Vaccinium vitis-idea*, *Althea officinalis*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic ***Capsella bursa-pastoris***, ***Urtica dioica*** (herbarium specimens)

Carefully study herbarium specimens of ***Capsella bursa-pastoris***, ***Urtica dioica*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)

- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)

- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

Practical lesson 6.

Topic: Rosoidae Subclass. The Rosaceae family.

Goals and objectives: to study: classification of Rosoidae Subclass; diagnostic features of Rosaceae Family representatives; morphological features of Rosaceae Family species – *Rosa canina*, *Potentilla erecta*, *Fragaria vesca*, *Crataegus sanguine*, *Rubus idaeus*, *Sanguisorba officinalis*, *Malus domestica*, *Sorbus aucuparia*, *Amygdalus communis*, *Padus avium* (by the herbarium specimens and tables); chemical composition of Rosoidae Subclasses species; poisonous plants of Rosaceae Family. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Rosa canina, Potentilla erecta*** (by herbarium specimens)

Carefully study herbarium specimens of ***Rosa canina, Potentilla erecta*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic of ***Fragaria vesca, Crataegus sanguine*** (by herbarium specimens)

Carefully study herbarium specimens of ***Fragaria vesca, Crataegus sanguine*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

• class, subclass, family, genus

***Life form*:**

• Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)

- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

Practical lesson 7.

Topic: Rosoidae Subclass. The Fabaceae Family, the Rhamnaceae Family, the Apiaceae Family, the Valerianaceae Family.

Goals and objectives: to study: classification of Rosoidae Subclass; diagnostic features of Fabaceae, Rhamnaceae, Apiaceae, Valerianaceae Families representatives; morphological features of Fabaceae Family species – *Arachis hypogaea*, *Astragalus dasyanthus*, *Glycine hispida*, *Glycyrrhiza glabra*, *Melilotus officinalis*, *Ononis arvensis*, *Rhobinia pseudoacacia* (by the herbarium specimens and tables); morphological features of Rhamnaceae Family species – *Frangula alnus*, *Rhamnus cathartica* (by the herbarium specimens and tables); morphological features of Apiaceae Family species – *Anetum graveolens*, *Anisum vulgare*, *Apium graveolens*, *Carum carvi*, *Cicuta virosa*, *Conium maculatum* (by

the herbarium specimens and tables); morphological features of Valerianaceae Family species – *Valeriana officinalis* (by the herbarium specimens and tables); chemical composition of Rosoidae Subclasses species; poisonous plants of Fabaceae, Rhamnaceae, Apiaceae Families. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Rhobinia pseudoacacia, Valeriana officinalis, Anethum graveolens*** (by herbarium specimens)

Carefully study herbarium specimens of ***Rhobinia pseudoacacia, Valeriana officinalis, Anethum graveolens*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)

- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

Practical lesson 8.

Topic: Lamiideae Subclass. The Lamiaceae Family, the Scrophulariaceae Family.

Goals and objectives: to study: classification of Lamiideae Subclass; diagnostic features of Lamiaceae, Scrophulariaceae Families representatives; morphological features of Lamiaceae Family species – *Lavandula angustifolia*, *Leonurus quinquelobatus*, *Melissa officinalis*, *Mentha piperita*, *Salvia officinalis*, *Thymus serpyllum*, *Origanum vulgare* (by the herbarium specimens and tables); morphological features of Scrophulariaceae Family species – *Digitalis lanata*, *Digitalis purpurea*, *Digitalis grandiflora*, *Verbascum phlomoides* (by the herbarium specimens and tables); chemical composition of Lamiideae Subclasses species; poisonous plants of Scrophulariaceae Family. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Leonurus quinquelobatus, Origanum vulgare*** (by herbarium specimens)

Carefully study herbarium specimens of ***Leonurus quinquelobatus, Origanum vulgare*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic of ***Verbascum phlomoides, Digitalis purpurea*** (by herbarium specimens)

Carefully study herbarium specimens of ***Verbascum phlomoides, Digitalis purpurea*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their

- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)

- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

Practical lesson 9.

Topic: Lamiideae Subclass. The Solanaceae Family, the Oleaceae Family.

Goals and objectives: to study: classification of Lamiideae Subclass; diagnostic features of Solanaceae, Oleaceae Families representatives; morphological features of Solanaceae Family species – *Atropa belladonna*, *Capsicum annuum*, *Datura stramonium*, *Hyoscyamus niger*, *Nicotina tabacum*, *Solanum tuberosum* (by the herbarium specimens and tables); morphological features of Oleaceae Family species – *Olea europaea* (by the herbarium specimens and tables); chemical composition of Lamiideae Subclasses species; poisonous plants of Solanaceae Family. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Datura stramonium, Solanum tuberosum*** (herbarium specimens)

Carefully study herbarium specimens of ***Datura stramonium, Solanum tuberosum*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)

- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous

- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

Practical lesson 10.

Topic: Asteridae Subclass. The Asteraceae Family.

Goals and objectives: to study: classification of Asteridae Subclass; diagnostic features of Asteraceae Family representatives;morphological features of Asteraceae Family species – *Centaurea cyanus*, *Echinaceae purpurea*, *Taraxacum officinale*, *Articum lappa*, *Tusilago farfara*, *Bidens tripartite*, *Achillea millefolium*, *Artemisia absinthium*, *Calendula officinalis*, *Chamomilla recutita* (by the herbarium specimens and tables); chemical composition of Asteridae Subclasses species; poisonous plants of Asteraceae Family. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Centaurea cyanus, Echinaceae purpurea*** (by herbarium specimens)

Carefully study herbarium specimens of ***Centaurea cyanus, Echinaceae purpurea*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground

- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)

- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic of ***Taraxacum officinale, Articum lappa,*** (by herbarium specimens)

Carefully study herbarium specimens of ***Taraxacum officinale, Articum lappa*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic of ***Tusilago farfara, Bidens tripartita*** (by herbarium specimens)

Carefully study herbarium specimens of ***Tusilago farfara, Bidens tripartita*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying, decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**
the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

Practical lesson 11.

Topic: Liliadae Subclass. The Alliaceae Family, the Convallariaceae Family, the Poaceae Family, the Araceae Family.

Goals and objectives: to study: classification of Liliadae Subclass; diagnostic features of Alliaceae, Convallariaceae, Poaceae, Araceae Families representatives; morphological features of Alliaceae Family species – *Allium cepa, Allium sativa* (by the herbarium specimens and tables); morphological features of Convallariaceae Family species – *Convallaria majalis*, *Polygonatum odoratum* (by the herbarium specimens and tables); morphological features of Poaceae Family species –*Triticum vulgare*, *Oryza sativa*, *Elytrigia repens*, *Avena sativa*, *Zea mays* (by the herbarium specimens and tables); morphological features of Araceae Family species – *Acorus calamus* (by the herbarium specimens and tables); chemical composition of Liliadae Subclasses species; poisonous plants of Convallariaceae Family. To be able to: recognize representatives of mentioned families; record and interpret formulas flowers which are studied; give English and Latin names to plants species which are studied.

Workflow

Morphological characteristic of ***Allium cepa, Convallaria majalis*** (by herbarium specimens)

Carefully study herbarium specimens of ***Allium cepa, Convallaria majalis*** and characterize them morphologically acceding to scheme given below.

***Classification*:**
•class, subclass, family, genus

***Life form*:**
•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**
- aerial , underground

- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)

- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Morphological characteristic of ***Polygonatum odoratum, Triticum vulgare*** (by herbarium specimens)

Carefully study herbarium specimens of ***Polygonatum odoratum, Triticum vulgare*** and characterize them morphologically acceding to scheme given below.

***Classification*:**

•class, subclass, family, genus

***Life form*:**

•Tree, shrub, subshrub, undershrub, lianas, herb (annual, biannual, perennial)

***Shoot*:**

- aerial, underground
- orthotropic (upright, climbing)
- plagiotropic (creeping, lying , decumbent)
- plagio-orthotropic (ascending, elevated, rising)
- length (cm)

***Stem*:**

- the shape (cylindrical, elliptical, triquetrous, tetrahedral, polyhedral, ribbed, striated, winged, culm)
- pubescence (present; absent)
- solid, hollow

***Metamorphoses of the shoot and its parts*:**

- underground (rhizome, tuber, bulb, bulbotuber)
- overground (thorns, tendril, runners, phylloclades, succulent (sappy stem), overground tuber, reproductive bud (bulbils))

***Arrangement of leaves on a plant stem*:**

- alternate, opposite, crosswise opposite, whorled, rosette

***The leaf*:**

- petiolar, sessile, decurrent, stem-clasping, perfoliate, opposite accrete, sheating leaf
- with stipules, without stipules
- with sheath or ocrea, or without their
- simple entire leaves *by form* (wide-ovate, ovate, tightly-ovate, linear, rounded, elliptical, oblong, lanceolate, wide-obovate, obovate, tightly-obovate, corymbose-shaped, needle-shaped, kidney-shaped, rhombus-shaped, triangular, falcated, spatulate, spear-shaped, cordate, sagittate, fan-shaped)
- simple entire leaves *by divided leaf blade* (trilobate, tripartite, trisected, palmalobate, palmapartite, palmasected, pinnatilobate, pinnatipartite, pinnatisected)
- compound leaves (tricompound, palmately compound, paripinnately compound, imparipinnately compound, twice-pinnately compound)

***Shapes of the leaf margins*:**

- entire, serrate, dentate, compound serrate, crenate, daedalous, large-daedalous, wavy, ciliated, plane, revolute

***Venation types*:**

- dichotomous, pinnate, palmate, palmate-pinnate, pinnate-arcuate, palmate-arcuate, arcuate, parallel

***Metamorphoses of the leaf and its parts*:**

- bud scale, tendrils, spines, storage leaves of the succulent, phyllode, reproductive leaves, floral leaves (bracts), insect-trapping leaves

***The inflorescence*:**

- simple monopodial (raceme, spike, umbel, corymb, catkin, spadix, head, anthodium)
- compound monopodial (panicle (compound raceme), compound spike, compound umbel, compound corymb, panicle of anthodiums, compound corymb of the anthodiums)
- sympodial (simple monochasium, winding, bostryx, glome, dichasium, pleiochasium, false whorl)
- thyrses (raceme of bostryx, amentum-like)

***The flower*:**

- symmetry (actinomorphous, zygomorphous, asymmetrical)
- perianth (composite, simple caliciform, simple corolliform, naked), color, chorisepalous or gamosepalous
- androecium (equal, didymous, tetradymous, free, monoadelphous, diadelphous, polyadelphous)
- gynoecium (monocarpous, apocarpous, cenocarpous)
- location of the ovary (superior, half-inferior, inferior)

***The fruit*:**

- type of the gynoecium, which a fruit is formed from (monocarpous, apocarpous, cenocarpous)
- origin (natural and false)
- consistency of the pericarp (dry and fleshy fruits)
- number of the seeds (one-seeded and many-seeded fruits)
- method of the seed release (dehiscent, indehiscent and disintegrating fruits)
- size, form, color, pubescense

***Part in use*:**

the flower, the fruits, the seeds, the leaves, the cortex, the root, the herb

Signature of teacher _____

INDEPENDENT WORK

Topic 1.
Characteristics of algae – Cyanophyta, Rhodophyta, Chlorophyta and Phaeophyceae. Morphological characteristics, the presence of biologically active substances, the use of representatives in pharmacy and medicine.

I. Actuality of the topic.

Algae is diverse and numerous ecological and biological thallose group of organisms used as a source of industrial raw materials, biologically active substances, medicines, food, perfume and cosmetics. This explains the necessity of studying morphological characteristics, classification, chemical composition of these organisms in the course «Pharmaceutical Botany».

II. Learning Objectives:

To:

- know the terminology: algology, thallus, cryophyton, termophyton, phytoneuston, phytoplankton, phytobentos, phytoedaphon, periphyton, sapropel.
- classify algae by the level of organization, structure,conditions and ways of life.
- describe the life forms of algae and structure of their thallus.
- know ways of algae's reproduction.
- compare the structure of red, brown and green algae.
- give concrete examples of algae that used in pharmacy and medicine.
- explain the reasons for use of algae in medicine.

Task 1. Answer the questions.

1. Give the definition of thallus.	
2. What is the name of algae that live in the water?	
3. The algae that from phytoedaphon grow on ……..substrate.	
4. Describe the thallus of *Fucus vesiculosus.*	

5. Name pigments of algae.	
6. What ways can algae reproduce?	
7. What algae are used to produce agar and carrageenan?	
8. To which division is owned *Laminaria japonica*?	
9. Name the representatives of green algae.	.
10. Name the representatives of blue-green algae.	

Task 2. Choose the correct answer in tests.

1. The study of the structure, chemical composition, distribution and use of algae engaged science …	A. geobotany B. phytocoenology C. mycology D. lichenology E. algology.
2. Algae of reservoirs that are attached to aquatic substrate is …..	A. cryophyton B. termophyton C. phytoplankton D. phytobentos E. phytoedaphon.
3. To the list of green algae accidentally came red. It is ….	A. *Porphyra* B. *Chlorella* C. *Ulothrix*

	D. *Chlamydomonas* E. *Spirogyra*.
4. The unsexual reproduction of algae is due to the formation of special structures, but the process is not involving …	A. zoospore B. gormogonia C. aplanospore D. akinete E. autospore.
5. During sexual process in algae the process of merging of two protoplasts of vegetative cells. This mechanism is called …	A. parthenogenesis B. gametogenesis C. conjgation D. morphogenesis E. sporogenesis.
6. The eukaryotic algae differ from prokaryotic absence of …	A. nucleus B. mitochondria C. ribosome D. plasmalemma or plasma membrane E. nucleoid.
7. Making the list of red algae, a student made a mistake, has included to it the representative of brown, namely ...	A. *Porphyridium* B. *Laminaria* C. *Gelidium* D. *Bangia* E. *Hildenbrandia.*
8. The algae cells have certain features of photosynthetic organelles called …	A. chloroplasts B. gametange C. chromatophores D. sporangium E. mesosome.
9. *Laminaria japonica* Aresch. belong to department ….	A. red B. blue-green C. green D. brown E. diatoms.
10. By the structure of thallome algae divided into	A. unicellular B. multicellular C. colonial.

Task 3. Complete the table.

Departments **Features**	**Blue-green**	**Green**	**Red**	**Brown**
The body color				

Pigments				
Food stock				
Representatives				
Using				

Signature of teacher _____

Topic 2.
Kingdom Fungi. Department of Lichens. Morphological characteristics, the presence of biologically active substances, the use of representatives in pharmacy, medicine and other fields.

I. Actuality of the topic.

Fungi is a group of apochlorotic heterotrophic eukaryotic organisms that combines some features of plants and animals. Fungi are important in nature, they are widely used by man, are the objects of microbiological studies and have medical significance. So, fungi involved in the circulation of substances in nature, enter into symbiosis with higher plants (mycorhiza); as a result of the ability to cause fermentation they are used in the food and pharmaceutical industry (production of protein-vitamin complexes, alcohol, drugs); number of species (yeast, *Claviceps purpurea* etc.) used in pharmacy and biotechnology as producers of carbohydrates, proteins, fats, enzymes, vitamins, antibiotics, alkaloids, steroid and growth hormones; some species are used for genetic research.

In the course of pharmaceutical and medical botany basic attention is given to macromycetes.

Lichens are symbiotic organisms with unique thallus consisting of mycobiont (fungus) and phycobiont (seaweed). This is an example of mutually beneficial type of symbiosis – mutualism, although some cases can be seen as antagonistic relationship. Lichen characterized by a high respiration, arrhythmy of photosynthesis, unusual metabolic plasticity. All of this gives them the opportunity well adapt to different environmental factors and survive, even with significant deterioration of environmental conditions.

All the above proves the necessity and importance of the studying by students- pharmacist the structural features, properties, features the use of certain fungi and lichens in medicine and pharmacy. This will create a theoretical and practical basis for learning other sciences – Microbiology, Pharmacognosy and clinical disciplines.

II. Learning objectives:

To:

- learn the terminology: chitin, plectenchyma, hypha, mycelium, conidium, sclerotium, ascus, basidium, fruit body, hymenophore, sporangiospore, zoospore, thallus;
- know the structural features of fungi (vegetative and fruit body);
- determine the nutrition's type of fungi and structures that providing process;
- know the types of fungi reproduction (vegetative, unsexual and sex) and prove the advantages and disadvantages of each;
- give a classification of fungi according to their morphological characteristics;
- learn the structural features of fungi classes Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes;
- learn the chemical composition, action and examples of fungi that have medical significance;
- be able to explain the life cycles of different classes of fungi, using tables;
- compare the structure of tubular and plate fungi using tabular material, and fixed specimens;
- give a comparative assessment of structural features fungi of the genus Mucor and Saccharomyces;
- give examples of different classes of fungi (Latin) that are relevant to Pharmacy and Medicine and the names of drugs that are based on fungi;
- identify the edible, conditionally edible and poisonous mushrooms;
- know the determination of lichens, be able to prove that these organisms are symbiotic;
- give classification of lichens by ecological status and morphological features;

- learn the structural features of the different types of lichens – homeomerous and heteromerous;
- distinguish cortical, foliose, thamnium lichens based on morphological characteristics;
- understand the differences between vegetative, sexual and unsexual reproduction of lichens;
- give examples of lichens (Latin) that are relevant to pharmacy and medicine and medicinal products derived from them;
- prove the importance fungi and lichens in nature and human life.

Task 1. Answer the questions.

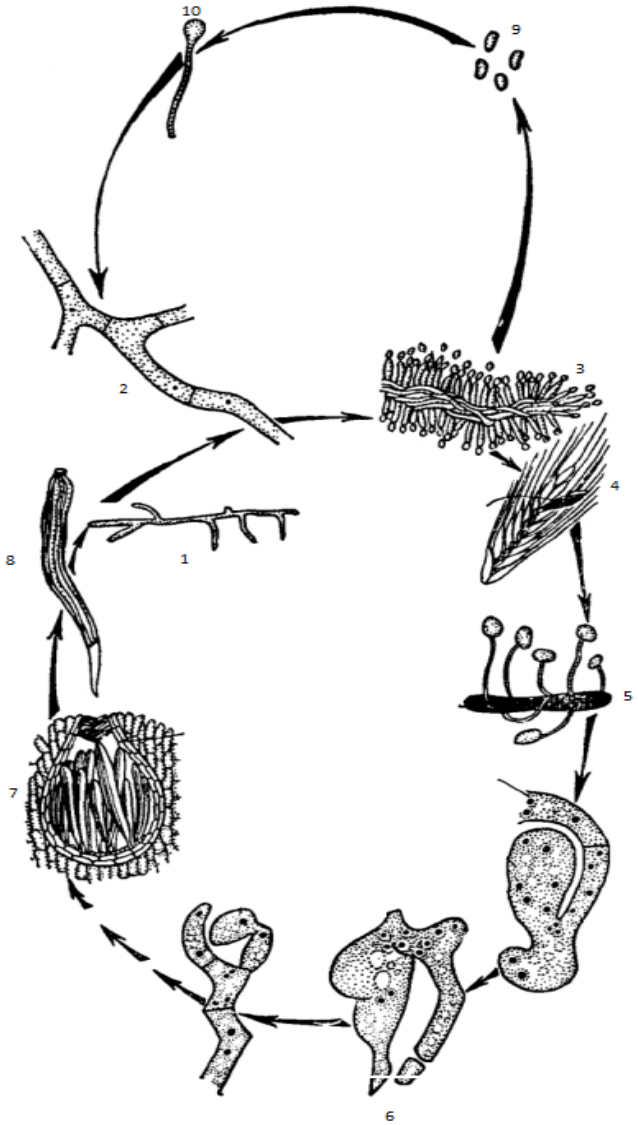
1. How is the science that study fungi?	
2. Which is the environmental group include mushrooms, that are powered by a soil humus, involved in the mineralization of organic substances enter into symbiosis with the roots of higher plants?	
3. Give an example of fungus which mycelium consists of unicellular fibers.	
4. Fungi used for nutrition ready organic compounds, and they are ...	
5. Name the types of fungi's reproduction.	
6. What is a nitrogen-containing polysaccharid take part of the cell membrane of the fungus?	
7. Unsexual reproduction of fungi is involving sporangiospores, zoospores and conidium-spores. Which of these spores are able to move?	
8. The body of lichen is closely connected with substrate, it is very difficult separated from him, has the form of grains. Which morphological group is lichens belong?	
9. Name the special formation of lichens, by which is unsexual reproduction of phycobiont.	
10. What is the name of lichen's vegetative body?	

Task 2. Choose the correct answer in tests.

1. Among the representatives of fungi meet that feed on wood. These fungi belong to the group ...	A. probiont B. xenobiont C. hygrophyte D. xylophyle E. zoophyle.
2. Ascomycetes are the multicellular organisms with segmented mycelium. One from these fungi this class characterized by the absence of mycelium and single-celled structure. It is …	A. *Claviceps purpurea* B. *Saccharomyces cerevisiae* C. *Morchella* D. *Kombucha* (tea fungus) E. *Tuber aestivum*
3. Study the fungus, which has branched mycelium non-numerical in cell membranes are cellulose, zoospores of fungus with 2 flagella. The study of the sexual process has proven that he is by the type of oogamy. This fungus belongs to the class ...	A. Zygomycetes, B. Ascomycetes, C. Basidiomycetes, D. Deuteromycetes E. Oomycetes.
4. The cell membrane of the fungus containing chitin, mycelium is well developed, branched, non-numerical. Fruit bodies are not formed. Reproduction is vegetative, unsexual and sex (zoogamy). Which fungus has such features?	A. *Penicillium* B. *Saccharomyces* C. *Aspergillus* D. *Mucor* E. *Claviceps.*
5. Lichen's mycobiont consists of ...	A. Oomycetes B. Blue-green algae C. Ascomycetes D. Brown algae E. Diatom algae.
6. One type of vegetative reproduction fungi carried by special formation in that have a shape of cones, balls and consist of closely woven hyphae with a hard shell which are able to germinate in the fruit body. These movements are called ...	A. chlamydospore B. sclerotium C. conidium D. spores E. oidium.
7. The mobile zoospores produced in some fungi take part in the process ...	A. vegetative reproduction B. unsexual reproduction C. sexual reproduction D. budding E. heterogamy.
8. To the list of representatives Ascomycetes accidentally fell fungus from the class Basidiomycetes. Specify it:	A. *Saccharomyces cerevisiae* B. *Verpa bohemica* C. *Fomes fomentarius* D. japonica fungus E. *Kombucha* (tea fungus)

9. 9. There are a number of fungi, the use of which can cause in humans poisoning and even deaths. These fungi are Ergot. What are the chemical substances of this fungus cause toxic effects?	A. flavonoid B. alkaloid C. saponins D. antibiotic E. chitosan
10. On the bark of trees found lichen *Evernia prunastri*. Which environmental group is it belong?	A. cortical B. foliose C. epigeic D. epilithophyte E. epiphyte.

Task 3. Mark the main stages of development of *Claviceps purpurea*.



Pic 22. The main stages of development of *Claviceps purpurea* [29].

1. _____
2. _____
3. _____

4. _____
5. _____
6. _____
7. _____
8. _____
9, 10. _____

Task 4. Give examples Basidiomycetes (at least 3), which differ by the type hymenophore.

Lamellar	Tubular

Task 5. Make a table of pileated fungi, dividing them into edible, conditionally edible and poisonous (cite at least 3 examples in each group).

Edible	Conditionally edible	Poisonous

Signature of teacher _____

Topic 3.
Magnoliidae Subclass. Magnoliaceae, Lauraceae, Schizandraceae Families. Ranunculidae Subclass. Berberidaceae Family.

I. Actuality of the topic.

Magnoliophyta (Anthophyta) is a progressive group of plants with intensive development. They are characterized by great morphological diversity of vegetative sporophytes, a significant reduction of gametophyte, lack archegonium and antheridium, the presence of flowers, sexual process by the type of double fertilization, seed development under pericarp protected. Flowering plants are divided into two classes – Monocots and Dicots.

Class Dicot – Magnoliopsida includes 8 Subclasses and 325 families. One of the Subclasses Magnoliidae combines the ancient plants by origin. Modern types of division are the remnants of the once dominant primitive flowering plants, which are considered the ancestors of today's angiosperms. Despite the relatively small number and diversity of these plants they make extensive interest for both specialists-botanist, and for pharmacists, because there are source of medicinal plants for creating effective drugs. Therefore, understanding of the structure, composition and knowledge of the diagnostic features needed to build the future baseline pharmacist.

Species of Subclass Ranunculidae are nearly of Subclass Magnoliidae by some morphological features, but more advanced evolutionarily.

Family Berberidaceae (Ranunculidae) brings together about 650 species of herbaceous and woody plants that live on land. The main feature inherent to these plants is the presence of the chemical composition of alkaloids. This fact indicates that these plants are poisonous. On the other hand, it is the presence of chemical, biological active compounds makes them invaluable importance for medicine and pharmacy, as some of these plants are used as medicinal plants. All of this proves the importance and necessity of studying in the course of pharmaceutical botany the diagnostic features barberry family, specific features of individual representatives, chemical composition and trends of medical plants.

II. Learning objectives:

To:

- know the classification of plants Division Magnoliophyta;
- allocate the main features of plants belonging to the class Dicots;
- examine the morphological structure of the representative Schizandraceae family – *Schizandra chinensis* by herbarium;
- distinguish the features of morphological structure representatives of the family Lauraceae – *Laurus nobilis* by herbarium;
- characterize different morphological features of the representative family Magnoliaceae – *Magnolia grandiflora*, paying particular attention to its fruits (complex apocarpous drupes) by herbarium specimens and micropreparations;

- allocate diagnostic features of plants of the family Berberidaceae;
- examine the morphological features of plants of the family Berberidaceae – *Berberis vulgaris* and *Podophyllum peltatum* (using herbarium and tables);
- make species diagnosis appointed representatives of families (by herbarium);
- be able describe and interpret of flowers plants formulas that studied;
- determine the types of fruit of presented plants (macropreparations and tables);
- be able give specific names of the plants studied Latin;
- master the chemical composition of plant parts of Ranunculidae and Magnoliidae Subclass, which are used as medicinal plants;
- understand the relationship of the chemical composition of plants with directions of medical use;
- be able give examples of medical forms and preparations obtained from medicinal plants that studied.

Task 1. Answer the questions.

1. Name the type of flower gynoecium of *Schizandra chinensis*.	
2. What part of *Berberis vulgaris* does use as a hemostatic and choleretic means?	
3. Give the Latin name of plant from the family Schizandraceae, the use of which leads to stimulation of the nervous system.	
4. What life forms are represente plants of the family Magnoliaceae?	
5. The leaves of the plant from Lauraceae family used as a spice. Give the Latin name of this plant.	
6. On which organic compounds are rich the fruit of *Persea americana* (avocados)?	
7. Leaves *Laurus nobilis* alternate, simple, dull leathery with a wavy edge. From below against the background of relatively light surface clearly seen numerous dark brown terms ….	
8. What family is belong *Cinnamomum camphora*?	
9. What part of *Berberis vulgaris* is a source of berberine?	
10. How is the name of preparation made from roots and rhizomes of *Podophyllum*	

peltatum?	

Task 2. Choose the correct answer in tests.

1. *Schizandra chinensis* is valuable medicinal plant. Determine which organs of the plant used to produce drugs.	A. roots B. rhizomes C. leaves D. flowers E. fruits.
2. Specify the plants whose bark used to produce cinnamon, which is used as an aromatic and spicy stuff.	A. *Cinnamomum camphora* B. *Laurus nobilis* C. *Cinnamomum zeylonicum* D. *Magnolia grandiflora* E. *Schizandra chinensis.*
3. Student makes flower's formula of *Magnolia obovata*. How does he mark perianth correctly?	A. simple cup-shaped B. binate C. naked D. complex E. simple corolla-like.
4. Student studies a formula of flower *Magnolia grandiflora* * ♀/♂ P^{Co}_{3+3+3} A_{∞} $\underline{G_{\infty}}$. How is the name of this type of gynoecium?	A. coenocarpous B. monocarpous C. apocarpous D. paracarpous E. lysicarpous.
5. To Subclass Magnoliidae belongs much families. Specify the family from one subclass, which includes valuable technical and spice plants.	A. Schizandraceae B. Lauraceae C. Magnoliaceae D. Aristolochiaceae E. Nymphaeaceae.
6. Studying a collection of fruits, student identified the sweet and sour taste of juicy red fruit aggregate, inside which are kidney-shaped seeds of bitter-astringent taste. What is plant's fruit student study?	A. *Laurus nobilis* B. *Adonis vernalis* C. *Schizandra chinensis* D. *Cinnamomum camphora* E. *Aconitum karakolicum.*
7. Specify the the plant from the family Berberidaceae, from the leaves are made tincture, which is used as a hemostatic and choleretic agent.	A. *Podophyllum peltatum* B. *Liriodendron tulipifera* C. *Laurus nobilis* D. *Berberis vulgaris* E. *Cinnamomum camphora.*
8. To the list of plants from the Lauraceae family accidentally was representative of the family Berberidaceae. Specify it.	A. *Cinnamomum camphora* B. *Laurus nobilis* C. *Cinnamomum zeylonicum* D. *Berberis vulgaris* E. *Persea drymifolia.*

9. Name the perennial herb with creeping rhizome with bunches of thin roots at the nodes, which used for the manufacture the choleretic drugs.	A. *Podophyllum peltatum* B. *Berberis vulgaris* C. *Laurus nobilis* D. *Liriodendron tulipifera* E. *Cinnamomum camphora.*
10. Specify the the plant from the family Berberidaceae, which flower are used for the manufacture of the yellow paint	A. *Podophyllum peltatum* B. *Berberis vulgaris* C. *Laurus nobilis* D. *Liriodendron tulipifera* E. *Cinnamomum camphora.*

Task 3. Complete table, describing these representatives.

Characteristics	***Magnolia grandiflora***	***Laurus nobilis***	***Schizandra chinensis***	***Berberis vulgaris***
Family				
life form				
Position of stems in space				
The shape of the stem				
The form of the leaf				
Inflorescence				
Formula of a flower				
Fruit				
That is used as a raw material				
Action				

Signature of teacher _____

Topic 4.
Cariophyllidae Subclass. Caryophyllaceae Family.
Hamamelididae Subclass. Uglandaceae Family.

I. Actuality of the topic.

The peculiarity of species of Subclass Hamamelididae is specialization of flowers and inflorescences, due to the transition from entomophily to anemophily. To the structure of Subclass Hamamelididae belong 23 families. The plants are deciduous – trees and shrubs. Medical application have bark, ripe and green fruit, stems, gauls, buds, sap, leaves, seeds that cause a wide range of therapeutic action – anti-inflammatory, astringent, anti-protist, diaphoretic, desensitizing, metabolic, etc. Since these plants are a source of valuable medicinal raw material, studying their morphological features and diagnostic features are appropriate in the course of pharmaceutical botany.

Representatives of Subclass Cariophyllidae mostly are the herbaceous plants and shrubs. This taxon includes many families, but special interest cause the *Caryophyllaceae*. It is a plant, spread mainly in the countries of the northern hemisphere with a moderate climates. The family has their morphological features and diagnostic features, knowledge of which is important because many species are considered medicinal and medicinal plant raw material for anti-inflammatory, hemostatic, diuretic, laxative, and so on. Knowledge of the morphology of these plants, the ability to correctly identify them by diagnostic signs of family and species characteristics, mastering the chemical composition and branches of medical application are important integral part of building a base for the theoretical knowledge and practical skills of professional pharmacy. That is why this Subclass plants studied in the course of medical botany.

II. Learning objectives:

To:

- know the Latin name of families of Subclasses Hamamelididae and Cariophyllidae: *Uglandaceae* and *Caryophyllaceae*, genus *Juglans*, *Dianthus*, *Saponaria*, *Herniaria* and the species names of plants belonging to them;
- give diagnostic features of Subclasses families Hamamelididae and Cariophyllidae;
- make a comparative analysis of plant's morphological features of the studied families (by herbarium);
- able to interpret formulas of flowers of specified plants families;
- describe the fruits of some representatives (specimens, tables);
- learn the chemical composition of plants Subclasses Hamamelididae and Cariophyllidae;
- know which part of different representatives of Subclasses serve as a source of medicinal plants;

➢ select directions of medical application some representatives and Subclasses Hamamelididae and Cariophyllidae: *Juglans regia*, *Herniaria glabra*, *Saponaria officinalis*, *Dianthus deltoides*.

Task 1. Answer the questions.

1. The leaves of plant from Subclass Hamamelididae contain aromatic and coloring substances. Leaves are big, alternate, odd-pinnate, with three or five pairs of elongated-ovate, pointed, naked on top, from below - in the corners veins hairy leaves. What is this plant?	
2. What is fruit inherent *Herniaria glabra*?	
3. What are the organs of *Saponaria officinalis* use with medicinal purposes?	
4. What is the inflorescence inherent to plants from the family *Caryophyllaceae*?	
5. Give Latin name of family to which belongs *Dianthus deltoides*.	
6. What is the part of *Herniaria glabra* use as medical raw materials?	
7. Name the type of gynoecium of plants from the family *Caryophyllaceae*.	
8. In which male flowers are gathered inflorescences of *Juglans regia*?	
9. What is the part of *Juglans regia* use with medicinal purposes?	
10. What are the representatives belong to *Caryophyllaceae*?	

Task 2. Choose the correct answer in tests.

1. Fruit of the plant from the family *Juglandaceae* hasn't wrap, his fleshy exocarp cast when ripe; seed surrounded by a thick lignify endocarp. So, this fruit is ….	A. nut B. pseudocarp drupe C. nutlet D. drupe E. aggregate.
2. In the all parts of *Saponaria officinallis* contains saponins, but their predominant number is in …	A. leaves B. roots C. seeds D. stems E. inflorescences.
3. From the following list of plants of Subclass	A. *Fagopyrum esculentum*

Cariophyllidae determine a representative who has dichasial cyme.	B. *Rumex confertus* C. *Saponaria officinallis* D. *Rheum palmatum* E. *Persicaria bistorta.*
4. Analysis of the chemical composition of plant seeds from family *Juglandaceae* reveals the vast number in it.	A. fatty oils B. essential oils C. proteins D. carbohydrates E. minerals.
5. Among the herbarium specimens student must select from the family *Caryophyllacea*, which have opposite leaf arrangement.	A. *Dianthus versicolor* B. *Dianthus deltoides* C. *Herniaria glabra* D. *Juglans regia* E. *Saponaria officinallis.*
6. Drugs with leaves and green pericarps which plants are used for rinsing with angina, gingivitis, stomatitis, periodontal disease, and so on.	A. *Dianthus versicolor* B. *Dianthus deltoides* C. *Herniaria glabra* D. *Juglans regia* E. *Saponaria officinallis.*
7. Among this list of fruits student must select one that is inherent to *Herniaria glabra*…	A. capsule B. one-seeded nutlet C. polyspermatous nutlet D. winged nut E. caryopsis.
8. To the list of plants of *Caryophyllaceae* accidentally got a representative from the *Juglandaceae* family. Identify it.	A. *Dianthus versicolor* B. *Dianthus deltoides* C. *Herniaria glabra* D. *Juglans regia* E. *Saponaria officinallis*
9. Name a perennial herb that belongs to the family *Caryophyllaceae* with creeping stems, small broadly ovate leaves, which is used as a diuretic.	A. *Dianthus versicolor* B. *Dianthus deltoides* C. *Herniaria glabra* D. *Juglans regia* E. *Saponaria officinallis.*
10. Specify the plant from family *Caryophyllaceae*, all of which have a large amount of saponins.	A. *Dianthus versicolor* B. *Dianthus deltoides* C. *Herniaria glabra* D. *Juglans regia* E. *Saponaria officinallis*.

Task 3. Fill in the table, describing specified representatives.

Characteristics	***Juglans regia***	***Herniaria glabra***	***Saponaria officinallis***
Family			
life form			
Position of stems in space			
The shape of the stem			
The form of the leaf			
Inflorescence			
Formula of a flower			
Fruit			
That is used as a raw material			
Action			

Signature of teacher _____

Topic 5
Dilleniidae Subclass. Theaceae, Salicaceae, Cannabaceae, Violaceae, Moraceae, Primulaceae, Euphorbiaceae, Sterculiaceae, Cucurbitaceae Families.

I. Actuality of the topic.

Subclass Dilliniidae is largest among subclasses of flowering plants, unites 95 families. Some species of this Subclass derived from magnolia, and have with them many common features. However, some families are very specialized and by the flowers structural features differ significantly from magnolia. The value of plants that belong to families considered on the lesson, is very large. Such plants as *Thea sinensis*, *Ficus carica*, *Morus alba* and *Morus nígra* people uses as food. However, this and other plants of these families are medicinal. Preparations «Sinuforte», «Urolesanum» and others that contain in their composition the raw plant materials of these families. Therefore, knowledge of morphological and anatomical characteristics chemo taxonomic features of these plants are necessary for students of pharmaceutical faculty in the course of pharmaceutical botany.

II. Learning objectives:

To:

- know the Latin names of families that are discussed in the topic of lesson and species names of certain representatives;
- give diagnostic features named families;
- explain what caused the medicinal properties of plant families that studied;
- characterize some representatives by herbarium;
- evaluate the state of natural resources of studied plants, by the literature;
- identify species from the studied families by herbarium;
- be able to write flowers formulas;
- distinguish fruits of plants from the studied families;
- explain the feasibility of application plants from the mentioned families in pharmacy and medicine.

Task 1. Answer the questions.

1. What are the parts of *Morus nigra* use in pharmacy and medicine?	
2. Consider the morphological characteristics of plant families *Tiliacaea*, *Sterculiaceae*, *Malvaceae*, *Clusiaceae*. Who from them have bacciform fruit?	
3. As a result of microscopic study of leaves epidermis *Thea sinensis*, *Morus alba*, *Salix caprea* and *Viola tricolor* in one of them discovered cystolith. For which of these plants they are typical?	
4. What is the type of symmetry typical for flower of *Viola tricolor*?	
5. During the microscopic study of leaves mesophillous of *Thea sinensis*, *Salix caprea* and *Viola tricolor* in one of them discovered sclereid. For which of these plants they are typical?	
6. In the list of these further plant select for which the is inherent fruit pepo: *Melo sativus*, *Humulus lupulus*, *Primula veris*, *Viola tricolor*.	
7. What type of inflorescence is typical for *Euphorbia virgultosa*?	
8. What kind of family are listed below representatives: *Manihot*, *Hevea brasiliensis*, *Aleurites fordii*, *Ricinus*	

communis?	
9. Among the plants listed select one which is characteristic fruit elongated box: *Melo sativus*, *Humulus lupulus*, *Salix alba.*	
10. Give an example of a plant from the family *Sterculiaceae.*	

Task 2. Choose the correct answer in tests.

1. For the collection need to add fruit fruits mode. What is the plant should select for it?	A. *Viola tricolor* B. *Ricinus communis* C. *Cannabis sativa* D. *Ficus carica* E. *Primula veris.*
2. To the list of plants of *Cucurbitaceae* family accidentally got representative of another family *Sterculiacea,* neamly …	A. *Cucurbita pepo* B. *Melo sativus* C. *Citrullus vulgaris* D. *Theobroma cacao* E. *Pepo* var. *clypeata.*
3. Some plants of Subclass Dilliniidae are poisonous. One of them is ...	A. *Ricinus communis* B. *Ficus carica* C. *Thea sinensis* D. *Morus nigra* E. *Viola tricolor*.
4. Rare plant species require protection measures from the state. These plants belong to ...	A. *Morus alba* B. *Humulus lupulus* C. *Salix caprea* D. *Populus nigra* E. *Primula officinalis*.
5. The grass contains glycoside rifle and alkaloids that cause drug addiction. What is the family of this plant?	A. *Papaveraceae* B. *Euphorbiaceae* C. *Cannabaceae* D. *Sterculiacea* E. *Primulaceae.*
6. Specify the plant which is characterized by the presence of collective fruit.	A. *Viola tricolor* B. *Thea sinensis* C. *Salix caprea* D. *Humulus lupulus* E. *Primula officinalis*.
7. Leaves of *Ficus carica* contain special cells-lithocyst with characteristic formations differentiated on the leg and body. These formations are called ...	A. fibril B. cystolith C. trichome D. strobile E. sorus.

8. In leaves mesophillous of *Thea sinensis* found elements of mechanical systems - many-branched cells. How are they called?	A. chalaza B. cystolith C. lithocyst D. trichoblast E. sclereids.
9. Specify the plant from Dilliniidae Subclass, underground body of which is spherical, slightly flattened tuberthat is raw material for medicines.	A. *Ricinus communis* B. *Cannabis sativa* C. *Cyclamen adshancum* D. *Humulus lupulus* E. *Euphorbia virgultosa*.
10. From seed of *Ricinus communis* obtained fatty oil, which is used in medicine. What is the effect from it?	A. hemostatic B. laxatives C. hypotensive D. soothing E. tonic.

Task 3. Fill in the table, describing these representatives.

Characteristics	***Primula officinalis***	***Ricinus communis***	***Viola tricolor***	***Cucurbita pepo***	***Salix alba***
Family					
life form					
Position of stems in space					
The shape of the stem					
The form of the leaf					
Inflorescence					
Formula of a flower					
Fruit					
That is used as a raw material					
Action					

Signature of teacher _____

Topic 6.
Rosoidae Subclass. Linaceae, Punicaceae, Myrtaceae, Saxifragaceae, Crassulaceae, Grossulariaceae Families.

I. Actuality of the topic.

Representatives of the mentioned families are herbaceous and woody evergreen or deciduous plants that are widely used by human. So, the fruits of *Ribes uva-crispa*, *Feijoa*, *Ribes nigrum*, as food, buds of *Syzygium aromaticum* as spices, but most representatives are medicinal plants, among which should be mentioned such as *Panax ginseng*, *Eleuterococcus senticosus*, *Kalanchoe pinnata*, *Eucalyptus*. These and many other plants of these families have an extremely wide range of therapeutic effects and are used for diseases of different organs and systems from ancient times. Clorophylliptum, Pectusinum, Laevovinisol, Anavenol and others, it's not the full list of drugs, which are used in the production of herbs. All of this proves the necessity of studying of morphology, anatomy, chemical composition, plant's resource volumes of the above families in the course of pharmaceutical botany.

II. Learning objectives:

To:

- know the Latin names of families that are discussed in the topic of lesson and species names of certain representatives;
- give diagnostic features named families;
- explain what caused the medicinal properties of plant families that studied;
- characterize some representatives by herbarium;
- evaluate the state of natural resources of studied plants, by the literature;
- identify species from the studied families by herbarium;
- be able to write flowers formulas;
- distinguish fruits of plants from the studied families;
- explain the feasibility of application plants from the mentioned families in pharmacy and medicine.

Task 1. Answer the questions.

1. What is the life form of *Bergenia crassifolia*?	
2. What is the part of *Punica granatum* is a source of medical tannin?	
3. The student identified *Rhodiola rosea* as a plant як рослину, that causes general stimulating, adaptogenic, anti-inflammatory and sedative effect. What is the mistake	

made a student?	
4. In the following list, choose such plant for which the inherent berry fruit: *Bergenia crassifolia*, *Ribes uva-crispa*, *Linum usitatissimum*, *Eucalyptus globulus*, *Punica granatum*.	
5. Give the Latin name of clove tree.	
6. Name the representatives from *Myrtaceae* family which is characterized by heterophylly	
7. What are form the petals of *Eucalyptus globulus* that liquify?	
8. Name the plant from the *Grossulariaceae* family, the fruits of which are used as antiscorbutic means?	
9. What are used as a raw material *Caryophyllus aromaticus*?	
10. In describing the stem of *Linum usitatissimum* student made a mistake. Find it: stem iserect, elastic, thin, pubescent.	

Task 2. Choose the correct answer in tests.

1. What is the part of *Linum usitatissimum* used as enveloping means?	A. stem B. seeds C. flowers D. roots E. leaves.
2. Specify the inflorescence of *Bergenia crassifolia*.	A. compound cyme B. monochasium C. panicle D. dichasium E. complex spike.
3. To the list of plants of the *Araliaceae* family was representative of the *Crassulaceae* family. Specify it.	A. *Panax ginseng* B. *Eleuterococcus senticosus* C. *Opiopanax elatus* D. *Kalanchoe pinnata* E. *Hedera taurica.*
4. *Bergenia crassifolia* is a rhizomatous herb, which is used as an astringent and anti-inflammatory. Specify the life forms of this plant.	A. tree B. subshrub C. herb D. shrub E. small shrub.

5. Among the plants listed below specify one that requires protection measures as a result of significant reductions in its natural undergrowth.	A. *Eleuterococcus senticosus* B. *Linum usitatissimum* C. *Ononis arensis* D. *Thermopsis lanceolata* E. *Rhodiola rosea*.
6. Frits of *Grossulariaceae* are rich in carotene, pectin, vitamins, organic acids, trace elements, so they are considered valuable food. These fruits are called ...	A. nuts B. drupe C. nutlets D. berries E. apples.
7. *Eucalyptus globulus* widely used for the treatment of diseases of the respiratory system. What is the part of the plant select for this?	A. leaves B. flowers C. roots D. pollen E. bark.
8. From the clove tree get spices that used by human as nutrition. For this purpose select ...	A. bark B. flower bud C. latex D. leaves E. pollen.
9. Which is the life form submit *Punica granatum*?	A. deciduous tree B. evegreen subshrub C. evegreen tree D. perennial grass E. liana.
10. Young shoots, seeds, fruits, leaves of *Myrtus communis* used as medicinal herbs. What is the effect do drugs derived from this raw material?	A. antipyretic B. antioxidants C. purgative D. anti-inflammatory E. adaptogens.

Task 3. Fill in the table, describing these representatives.

Characteristics	***Bergenia crassifolia***	***Rhodiola rosea***	***Ribes nigrum***	***Eucalyptus globulus***	***Punica granatum***	***Linum usitatissimum***
Family						
life form						
Position of stems in space						
The shape of the stem						
The form of the leaf						
Inflorescence						
Formula of a flower						
Fruit						
That is used as a raw material						
Action						

Signature of teacher _____

Topic 7.
Rosoidae Subclass. Rutaceae, Viburniaceae, Adoxaceae, Hippocastanaceae, Araliaceae Families.

I. Actuality of the topic.

The study of morphological, chemo-taxonomic, anatomical features of plant families *Rutaceae*, *Viburniaceae*, *Adoxaceae*, *Hippocastanaceae* and *Araliaceae* is very important in the course of pharmaceutical botany, because the fruits, buds, leaves, bark, roots of these plants are valuable medicinal raw materials. Tincture of *Ruta graveolens* used to treat skin diseases, essential oils of citrus – in cosmetics, perfumes, aromatherapy, extract, decoction of the bark of viburnum – bleeding, bark and roots elderberry as a laxative, extract of the ginseng as an immunomodulator. The fruits of these plants are foods rich in sugars, organic acids, flavonoids, minerals, and thus their study improves overall condition, strengthens the immune system.

II. Learning objectives:

To:

- know the Latin names of families that are discussed in the topic of lesson and species names of certain representatives;
- give diagnostic features named families *Rutaceae, Viburniaceae, Adoxaceae*, *Hippocastanaceae*, *Araliaceae*;
- explain what caused the medicinal properties of plant families that studied;
- characterize some representatives by herbarium;
- evaluate the state of natural resources of studied plants, by the literature;
- identify species from the studied families by herbarium;
- be able to write flowers formulas;
- distinguish fruits of plants from the studied families;
- explain the feasibility of application plants from the mentioned families in pharmacy and medicine.

Task 1. Answer the questions.

1. How is the fruit that inherent for plants from *Citrus* genus?	
2. One of the characteristic features *Rutaceae* is the presence in different parts a large number of aromatic conceptacle. What are their type?	
3. Give an example of a plant from the *Rutaceae* family with double- or thrice dissected leaves.	
4. Exocarp of the fruits of *Citrus sinensis* has	

має yellow-orange color due to the presence in its specific pigment cells. What is it?	
5. The flowers of *Viburnum opulus* collected in corymb inflorescence. What are the types of flowers by sex include to it?	
6. What is the part of *Panax ginseng* use as medicinal raw?	
7. What is the type of flower symmetry of *Citrus limon*?	
8. Citral obtained from lemon, is indicated for hypertension and in ophthalmology. This aldehyde contained in the ...	
9. What are the parts of *Sambucus nigra* use as medicinal raw?	
10. Name the fruit of *Aesculus hippocastanum.*	

Task 2. Choose the correct answer in tests.

1. When creating a morphological herbarium student needed sheets with winged petioles. Which plants do have such leaves?	A. *Urtica dioica* B. *Citrus limon* C. *Citrus paradisii* D. *Tilia cordata* E. *Hypericum perforatum.*
2. Preparation of flower *Sambucus nigra*, student noted that her pistil has three dissepiment ovary and half fused with other parts of the flower. That ovary ...	A. upper B. lower C. half-inferior D. half-superior E. complex.
3. In the plants of Citrus genus essential oils accumulate in the expcarp of fruit (bitter orange). In which secretory structures of exocarp do accumulate essential oils?	A. lysigenicous conceptacle B. schizogenous conceptacle C. milk vessel D. gland E. glandular hair.
4. A characteristic feature of representatives the *Rutaceae* family is the presence mesophillous in leaves and fruits ...	A. hydatod B. resin channel C. essential-oil conceptacle F. milk vessel D. nectar.
5. In the collection found fruit spherical box with spikes. It opens by two orals, contains one large, dark brown, shiny seed with a light matte stain. This box has ...	A. *Gossypium hirsutum* B. *Papaver somniferum* C. *Datura stramonium* D. *Ledum palustre* E. *Aesculus hippocastanum.*
6. Specify plant from *Citrus* genus is a hybrid	A. *Citrus limon*

Citrus maxima and *Citrus sinensis.*	B. *Citrus aurantium* C. *Citrus bergamia* D. *Citrus paradisii* E. *Citrus sinensis*.
7. Among the list of representatives of *Araliacaea* family select those that have fruit berry.	A. *Echinopanax elatum* B. *Panax ginseng* C. *Aralia mandshurica* D. *Hedera helix* E. *Eleutherococcus senticocus*.
8 In the inflorescence of *Viburnum opulus* are two types of flowers. Choose which features are typical for the boundary flower inflorescence.	A. bisexual B. sterile C. perianth naked D. perianth double E. perianth corolliform.
9. Specify a tree from *Araliacaea* family roots of which are used as a tonic.	A. *Echinopanax elatum* B. *Panax ginseng* C. *Aralia mandshurica* D. *Hedera helix* E. *Eleutherococcus senticocus.*
10. The flower of Citrus limon reflects the following formula: *♂♀ $Ca_{(4-5)}$ $Co_{(4-5)}$ $A_{(\infty)+(\infty)+(\infty)}$ $\underline{G_{(4-10)}}$. Specify the type of gynoecium.	A. coenocarpous B. apocarpous C. monocarpous D. lysicarpous E. paracarpous.

Task 3. Fill in the table, describing these representatives.

Characteristics	***Panax ginseng***	***Sambucus nigra***	***Viburnum opulus***	***Citrus limon***	***Aesculus hippocastanum***
Family					
life form					
Position of stems in space					
The shape of the stem					
The form of the leaf					
Inflorescence					
Formula of a flower					
Fruit					
That is used as a raw material					
Action					

Signature of teacher _____

Topic 8.
Lamiidae Subclass. Apocynaceae, Boraginaceae Families.

I. Actuality of the topic.

Medicinal plants of named families is the raw material for the production of drugs, which are widely used in medicine to treat diseases of the nervous, digestive, excretory, cardiovascular and other systems. These are drugs as a Vincapan, Cystenal obtained from the raw materials of these plants. So the importance of representatives of families *Apocynaceae*, *Boraginaceae* makes it necessary to study their anatomical and morphological characteristics, diagnostic and specific features of pharmaceutical faculty students in the course of pharmaceutical botany.

II. Learning objectives:

To:

- know the Latin names of families that are discussed in the topic of lesson and species names of certain representatives;
- give diagnostic features named families;
- explain what caused the medicinal properties of plant families that studied;
- characterize some representatives by herbarium;
- evaluate the state of natural resources of studied plants, by the literature;
- identify species from the studied families by herbarium;
- be able to write flowers formulas;
- distinguish fruits of plants from the studied families;
- explain the feasibility of application plants from the mentioned families in pharmacy and medicine.

Task 1. Answer the questions.

1. What is presented underground organ of *Symphytum officinale*?	
2. To the list of plant from *Boraginaceae* family accidentally got representative *Apocynaceae* Name it: *Symphytum officinale*, *Cynoglossum officinale*, *Strophanthus hispidus*, *Pulmonaria obscura*.	
3. What is part of *Pulmonaria obscura* use as medicinal plant raw material?	
4. Give the Latin name of perennial rough bearded (*Boraginaceae* family), has a flower with five lepidoid appendages in	

fauces assembled in the cincinnus.	
5. *Catharanthus roseus* widely used in medicine. What parts of this plant are take in order to obtain drugs?	
6. What is fruit inherent to *Borago officinalis*?	
7. Specify a representative of the family *Apocynaceae* medicines which reduce blood pressure, spasms of the brain vessels, dilates blood vessels.	
8. Among the list of fruits choose the one that belongs to *Nerium oleander:* long narrow capsule, coenobium, pseudomonocarpous drupe, box.	
9. What is the fruit typical for of the *Vinca* genus?	
10. By type of flower's symmetry plants from the *Apocynaceae* family are …	

Task 2. Choose the correct answer in tests.

1. Specify family which representatives have schizocarpic follicle fruit.	A. *Apocynaceae* B. *Plantaginaceae* C. *Poaceae* D. *Boraginaceae* E. *Asteraceae.*
2. What is the plant from among the following is poisonous?	A. *Vinca minor* B. *Plantago major* C. *Symphytum officinale* D. *Rubia tinctorum* E. *Coffea arabica.*
3. A characteristic feature of some plants is the presence milky juice – latex. One such plant is ...	A. *Cinchona pubescens* B. *Nerium oleander* C. *Coffea arabica.* D. *Borago officinalis* E. *Plantago major.*
4. Studying herbarium samples of *Strophanthus hispidus, Vinca minor, Nerium oleander.* What is their family?	A. *Plantaginaceae* B. *Scrophulariaceae* C. *Rubiaceae* D. *Apocynaceae* E. *Boraginaceae.*
5. Specify family, representatives of which are characterized by coenobium fruit.	A. *Plantaginaceae* B. *Scrophulariaceae* C. *Rubiaceae*

	D. *Apocynaceae* E. *Boraginaceae.*
6. Simple entire, alternate leaves of plants from Subclass Lamiidae covered by rough hairs. Microscopic examination revealed in them cystolith. Which plant they may be inherent?	A. *Cinchona pubescens* B. *Nerium oleander* C. *Symphytum officinale* D. *Borago officinalis* E. *Plantago major.*
7. Specify the plant from the *Boraginaceae* family, from the the leaves made tincture, which is used as a diaphoretic, diuretic and for dyeing in blue.	A. *Symphytum officinale* B. *Cynoglosum officinale* C. *Echium vulgare* D. *Borago officinalis* E. *Pulmonaria officinalis.*
8. To the list of plants of the *Apocynaceae* family accidentally got representative from the *Boraginaceae* family. Specify it.	A. *Nerium oleander* B. *Vinca minor* C. *Rauwolfia serpentia* D. *Symphytum officinale* E. *Strophantus hispidus.*
9. Name a perennial herb from the *Boraginaceae* family in all part of which are alkaloids and roots and leaves of which are used as a sedative.	A. *Symphytum officinale* B. *Cynoglosum officinale* C. *Echium vulgare* D. *Borago officinalis* E. *Pulmonaria officinalis.*
10. Specify plant from the *Apocynaceae* family, the seeds of which are used for making drugs cardiac action.	A. *Trachomitum cannabinum* B. *Vinca minor* C. *Rauwolfia serpentia* D. *Symphytum officinale* E. *Strophantus hispidus.*

Task 3. Fill in the table, describing these representatives.

Characteristics	***Vinca minor***	***Nerium oleander***	***Symphytum officinale***	***Borago officinalis***
Family				
life form				
Position of stems in space				
The shape of the stem				
The form of the leaf				
Inflorescence				
Formula of a flower				
Fruit				
That is used as a raw material				
Action				

Signature of teacher _____

Topic 9.
Lamiidae Subclass. Rubiaceae, Plantaginaceae, Oleaceae Families.

I. Actuality of the topic.

Medicinal plants of these families are the raw material for the production of drugs, which are widely used in medicine to treat diseases of the nervous, digestive, excretory, cardiovascular and other systems. These are drugs as Chinini hydrochloridum, Plantaglucidum obtained from raw materials of these plants. So important of representatives of the *Rubiaceae*, *Plantaginaceae*, *Oleaceae* families makes it necessary to study their anatomical and morphological characteristics, diagnostic and specific features by the students of pharmaceutical faculty in the course of pharmaceutical botany.

II. Learning objectives:

To:

- know the Latin names of families that are discussed in the topic of lesson and species names of certain representatives;
- give diagnostic features named families;
- explain what caused the medicinal properties of plant families that studied;
- characterize some representatives by herbarium;
- evaluate the state of natural resources of studied plants, by the literature;
- identify species from the studied families by herbarium;
- be able to write flowers formulas;
- distinguish fruits of plants from the studied families;
- explain the feasibility of application plants from the mentioned families in pharmacy and medicine.

Task 1. Answer the questions.

1. What is the part of *Cinhona succirubra* use in pharmacy and medicine?	
2. Studying the morphological characteristics of plants *Rubia tinctorum*, *Coffea*, *Cinchona pubescens*. Who from them have berrylike fruit?	
3. Select from the following list of species whose juice is used in chronic gastritis, enteritis, colitis: *Olea eoropaea*, *Plantago major*, *Coffea*, *Cinchona pubescens*.	
4. What is the type of symmetry characteristic for the flower of *Plantago major*?	

5. What is the purpose of using the rhizome with roots of *Rubia tinctorum* in medicine and pharmacy?	
6. What is the part of *Coffea* use as stimulating of the central nervous system, stimulant the respiratory center, tonic?	
7. What is the type of inflorescence characteristic for *Olea eoropaea*?	
8. What is the family includ representatives listed below: *Rubia tinctorum*, *Coffea*, *Cinchona pubescens*?	
9. What are the life forms represent plants of *Rubiaceae* family?	
10. Give an example of a plant from the *Plantaginaceae* family.	

Task 2. Choose the correct answer in tests.

1. What is an underground organ of *Rubia tinctorum*?	A. rhizome B. corm C. simple bulb D. tuber E. root-tuber.
2. Specify the inflorescence inherent for *Plantago major*.	A. anthodium B. corymb C. spike D. umbel E. dichasium.
3. Different parts of plants can be as medicinal raw materials. Thus, in order to obtain drugs from *Cinchona pubescens* using ...	A. seed B. fruits C. leaves D. bark E. roots.
4. The flower formula of *Cinchona pubescens* *♀♂$Ca_{(5)}Co_{(5)}A_5\underline{G_{(2)}}$. What is the type of gynoecium?	A. coenocarpous B. monocarpous C. apocarpous D. paracarpous E. lysicarpous.
5. Among the listed plants specify one that is deciduous.	A. *Coffea arabica* B. *Cinchona pubescens* C. *Olea eoгopaea* D. *Vinca minor*

	E. *Rubia tinctorum.*
6. Beverages and preparations of plants from *Rubiaceae* family contraindicated for children in connection with the possible emergence of addiction. Name this plant.	A. *Cinchona succirubra* B. *Coffea arabica* C. *Rubia tinctorum* D. *Olea europaea* E. *Galium verum.*
7. For fruit's collection need to add fruit of conical box. What is the plant for this must take away?	A. *Plantago major* B. *Coffea arabica* C. *Rubia tinctorum* D. *Olea europaea* E. *Galium verum.*
8. To the list of plant from *Rubiaceae* family e accidentally got representative of *Oleaceae* family. Specify it.	A. *Cinchona succirubra* B. *Coffea arabica* C. *Rubia tinctorum* D. *Olea europaea* E. *Galium verum.*
9. Specify that part of *Olea europaea* that student should take as a source of fatty oil.	A. flowers B. fruits C. leaves D. bark E. root.
10. Specify the plant from *Rubiaceae* family, whose bark is the source of quinine.	A. *Cinchona succirubra* B. *Coffea arabica* C. *Rubia tinctorum* D. *Olea europaea* E. *Galium verum.*

Task 3. Fill in the table, describing these representatives.

Characteristics	***Rubia tinctorum***	***Olea europaea***	***Plantago major***
Family			
life form			
Position of stems in space			
The shape of the stem			
The form of the leaf			
Inflorescence			
Formula of a flower			
Fruit			

That is used as a raw material			
Action			

Signature of teacher _____

Topic 10.
Bases of ecology, phytocenology and plant geography. Type of vegetation. Rational use, preservation and renovation of resources of medicinal plants.

I. Actuality of the topic.

Plant organisms exist in close relationship with the environment. Influence of different natural and anthropogenic factors significantly changes the structure of plant communities and the number of individual species. Therefore, the study of botany and elements of f phytoecology are necessary for generalization knowledges of individual sections of pharmaceutical botany.

II. Learning objectives:

To:

- know the terminology: phytoecology, geobotany, phytosphere, ecosystem, hydrophyte, hygrophyte, hydatophyte, mesophyte, ephemerous plant, ephemeroid, xerophyte, oligotrophic plant, eutrophic, meson, psammophyte, lithophyte, glycophyte, glycophyte, acidophilous plant, basiphilous plant, phanerophyte, chamephyte, hemicryptophyte, cryptophyte, therophyte, flora, landscape, phenological phase;
- give examples of environmental factors;
- classify plants according to relation moisturizing habitat, to temperature, light, soil;
- distinguish life forms of plant (by the classification of C. *Raunkiaer* and V. G. Serebrykov);
- identify phenological phase of vegetation of herbaceous plants;
- give the comparative characteristic of floristic regions of the Earth;
- understand the essence of security measures implemented for the conservation and restoration of plant of resources, including medicines.

Task 1. Answer the questions.

1. What are the questions examine geobotany?	

2. Give the definition «ecosystem».	
3. Name the climate factors of influence to plant.	
4. Identify the ecological group of plants in relation to the moistening of habitat.	
5. Name six floristic regions of the Earth.	
6. What are the environmental groups of plants distinguish the depending on requirements the lighting?	
7. What is the phenomenon of photoperiodism	
8. Name the ecological group of plants according to their requirements for soil (depending on the needs of certain chemical elements)	
9. Give the classification of life forms of plants by C. *Raunkiaer*.	
10. What is ephemerous plant? Give an example.	

Task 2. Choose the correct answer in tests.

1. Olive, almond, laurel have a device to reduce transpiration, so they belong to the group ...	A. ephemerous plant B. ephemeroid C. xerophyte D. nitrophobous E. heliophyte.
2. The largest geobotanical unit is aggregate of similar plant communities, called ...	A. phytocenosis B. biome C. geocenosis D. ecosystem

	E. vegetable association.
3. In order to compare the teachings of floras of the Earth US is divided into floristic region. How many do such areas exist?	A. 4 B. 6 C. 8 D. 10 E. 2.
4. Specify for which area of the Earth is characterized by such plants as bamboo, ficus, coffee tree?	A. Holarctic B. Paleotropic C. Neotropic region D. Australian E. Cape F. Frigid zone.
5. In most of herbaceous plants buds of recovery are on the ground level or partially immersed in it. What is the life form of such plants by classification of C. *Raunkiaer*?	A. phanerophyte B. chamephyte C. hemicryptophyte D. cryptophyte E. therophyte.
6. Landscape of areas created naturally and artificially, with certain characteristics of topography, soil, etc., called ...	A. biota B. vegetable association C. type of vegetation D. landscape E. area.
7. Determine studying of which questions does not deal phytoecology.	A. the rational use of plant resources B. prediction of changes in the plant world C. the morphology and anatomy of plants D. restoration of plant resources E. the relationship of plants with the environment.
8. What are the environmental factors do not belong to the abiotic?	A. soil B. geological C. microgennes D. topographical E. climate.
9. Enter the name of ecological group of plants that grow in temperate moisture.	A. hydrophyte B. hygrophyte C. hydatophyte D. mesophyte E. xerophyte.
10. Reaction of plants to light during the day length is called ...	A. phototaxis B. phototropism C. photonasty

	D. phototrophy E. photoperiodism.

Task 3. Complete the tables.

Ecological groups of plants according to the requirements of moistening habitat	hydrophyte	hydatophyte	hygrophyte	mesophyte	xerophyte
Examples of plants					

Ecological groups of plants according to lighting	heliophyte	sciophyte	scioheliohyte
Examples of plants			

Signature of teacher _____

Topic 11.
Liliadae Subclass. Melanthiaceae, Liliaceae, Hyacinthaceae, Asparagaceae, Arecaceae Families.

I. Actuality of the topic.

Among angiosperms the share Liliidae accounts for approximately 25% of the plants. The value of this Subclass of plants is very high. Some of them are used as food (onion, garlic, cereals, coconut and date palms, pineapple, banana). At the same time, these and other representatives contain in the chemical composition of biologically active substances, that impact on various parts of metabolism, and in addition, serve as plant material for production of medications. All this explains the need to study morphological characteristics, chemical composition and use plant of the mentioned families in the course of of pharmaceutical botany.

II. Learning objectives:

To:

- know the Latin names of families that are discussed in the topic of lesson and species names of certain representatives;
- give diagnostic features named families;
- explain what caused the medicinal properties of plant families that studied;
- characterize some representatives by herbarium;
- evaluate the state of natural resources of studied plants, by the literature;
- identify species from the studied families by herbarium;
- be able to write flowers formulas;
- distinguish fruits of plants from the studied families;
- explain the feasibility of application plants from the mentioned families in pharmacy and medicine.

Task 1. Answer the questions.

1. What is the part of *Veratrum lobelianum* use in pharmacy and medicine?	
2. Examines the morphological characteristics of plants *Colchicum autumnale*, *Drimia maritima*, *Asparagus officinalis*. Who from them have the berry fruit?	
3. Select from the following list of species, the young underground shoots which are used in food: *Cocos nucifera, Asparagus officinalis, Veratrum lobelianum.*	
4. What is the type of flower symmetry characteristic for the flower *Tulipa schrenkii*?	
5. What is the purpose bulbs of *Drimia maritima* use in pharmacy and medicine?	
6. What is the part of *Asparagus officinalis* use to reinforce the kidneys?	
7. What is the fruit of *Cocos nucifera*?	
8. Which are families of listed below representatives *Veratrum lobelianum, Colchicum autumnale*?	
9. What are the life forms of species from *Liliaceae* family?	

10. Give examples of plants from *Arecaceae* family	

Task 2. Choose the correct answer in tests.

1. To the list of plant of Liliidae Subclass accidentally got representative Asterids Subclass. Specify it.	A. *Asparagus officinalis* B. *Allium cepa* C. *Veratrum lobelianum* D. *Helianthus annuus* E. *Drimia maritima*.
2. Flowers of *Hyacinthaceae* are actinomorphic, bisexual, with corolla collected in apical buds ...	A. raceme B. corymb C. spadix D. anthodium spike.
3. What is the correctly name of fruit of *Cocos nucifera*?	A. juicy drupe B. nut C. box D. berry E. dry drupe.
4. One of the following genus of plants does not belong to the *Liliaceae* family. Specify it.	A. *Lilium* B. *Tulipa* C. *Hyacinthus* D. *Fritillaria* E. *Gagea*.
5. *Colchicum autumnale* is – perennial herb with an underground corm organ, basal rosette of leaves, single flowers with a simple perianth. What is the fruit inherent this plant?	A. aggregate B. achene with bangs C. juicy drupe D. dry drupe E. box-shaped 3-follicle.
6. What is the family of *Veratrum lobelianum*?	A. *Asparagaceae* B. *Melanthiaceae* C. *Arecaceae* D. *Liliaceae* E. *Hyacinthaceae.*
7. Stems of plant from the *Solanaceae* don't have cambium. Why can they thicken?	A. colenchyma B. sclerenchyma C. parenchyma D. secondary generating tissue E. mechanical tissue.
8. In *Asparagus officinalis* function of leaves perform thin filamentous green branches, called ...	A. cladode B. phyloid C. spine D. phylode E. stick.

9. Rare plant species require of protection measures from the state. To these plants in Ukraine belongs ...	A. *Hierochloe odorata* B. *Asparagus officinalis* C. *Elymus repens* D. *Colchicum autumnale* E. *Amaryllis belladonna.*
10. Some plants of Liliidae Subclass are poisonous. Specify such plant.	A. *Hierochloe odorata* B. *Asparagus officinalis* C. *Elymus repens* D. *Aloe arborescens* E. *Amaryllis belladonna.*

Task 3. Fill in the table, describing these representatives.

Characteristics	***Cocos nucifera***	***Asparagus officinalis***	***Drimia maritima***	***Colchicum autumnale***
Family				
life form				
Position of stems in space				
The shape of the stem				
The form of the leaf				
Inflorescence				
Formula of a flower				
Fruit				
That is used as a raw material				
Action				

Signature of teacher _____

GLOSSARY OF TERMS

ABAXIAL, the parts of a flower or leaf furthest from the axis of the branch or stem on which it grows (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ACICULAR, needle-shaped (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ACTINOMORPHIC, a flower in which the segments of the perianth, or the parts of either of the two whorls of the perianth (calyx and corolla) are alike in size and shape (although in the latter case the two whorls need not have the same number of parts), and are arranged regularly round the axis. Such flowers are buttercup, poppy, *Boronia, Geranium,* Brassicaceae, etc (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ADAXIAL, the parts of a flower nearest to the axis of the branch (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ADVENTITIOUS, any organ produced in an abnormal position. For example, adventitious roots arise from stems and not as branches of other roots (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ADVENTIVE, introduced accidentally or deliberately by humans to a specifies geographical area, as are most weeds (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

AERIAL The parts of plants growing above ground (M. Moore, 1995).

AGGREGATE FRUITS are the product of several distinct pistil ripening in one flower, the cluster of carpels being crowded on the receptacle in one mass, as in the Raspberry, Blackberry, and Strawberry (H.W. Yongken, 2013).

ALTERNATE Having plant parts, particularly leaves, arranged alternately along a stem, as opposed to in pairs or whorled (M. Moore, 1995).

ALTERNATE, (1) leaves or flowers inserted individually at different heights along the branches; (2) intervening between; as stamens which are between rather that opposite the petals in most flowering plants (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

AMPLEXICAUL, with the base (of a leaf) clasping the stem (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ANDROECIUM, a collective name for the stamens (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ANDROGYNOPHORE, a column composed of an ovary on a long stalk to which the stamens are attached. The staminal filaments form a connate tube and the stamens continue past the ovary and the free parts hold the anthers (Passifloraceae) (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ANDROGYNOUS, when male and female flowers are mixed in a spike or head.

ANDROMONOECIOUS, male and bisexual flowers developing on different individuals (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ANGIOSPERMS, plants having seeds enclosed in a seed vessel (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ANNUAL, a plant flowering and dying in one year (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ANTHERIDIUM, the male reproductive organ, as occurs in the gametophytes of ferns (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

APOCARPOUS, a pistil or gynoecium consisting of one carpel, or of several carpels all free and distinct (Ranunculaceae, Dilleniaceae) (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ARBORESCENT, tree-like (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ARCHEGONIUM, the female reproductive organ, as occurs in the gametophytes of ferns (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BALSAMIC Soft or hard plant or tree resins composed of aromatic acids and oils. These are typically used as stimulating dressings and aromatic expectorants and diuretics. This term is also applied loosely to many plants that may not exude resins but which have a soothing, pitchy scent. Examples: Balsam Poplar, ***Eriodicyon***(M. Moore, 1995).

BARK or **BORK** is a term applied to all that portion of a woody exogenous plant axis outside of the cambium line (H.W. Yongken, 2013).

BASAL At or near the base, such as leaves sprouting directly from root or crown (M. Moore, 1995).

BERRY, a juicy fruit with the seeds immersed in the pulp (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BIENNIAL, a plant which flowers and dies in the second year (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BIPINNATE A pinnate compound leaf whose leaflets, in turn, are stems that have pinnate leaflets (M. Moore, 1995).

BIPINNATE, applied to those leaves in which there are primary pinnate divisions (pinnae) which are themselves pinnate (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BISEXUAL, a flower with the reproductive organs of both sexes (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BITERNATE A compound leaf divided in threes, whose leaflets are in turn divided in pairs (M. Moore, 1995).

BRACTEOLE, a small bract on the pedicel or even on the calyx. Bracteoles are usually two, and often placed opposite each other (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BUDS are rudimentary stems with rudimentary leaves compactly arranged upon them (H.W. Yongken, 2013).

BULB, a short thick and fleshy rootstock in which the bud or buds are covered by fleshy leaf-scales (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

BULBIL, a small bulb, especially when a plant has several of them. Sometimes loosely used for similar small corms (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CALLUS, (1) a hard protuberance on some petals such as the standard of *Swainsona* and the labellum of some orchids, (2) a hardened decurrent extension of the lemma along the rhachilla in some grasses, such as *Stipa*: this callus and the adnate article of the rhachilla fall off with the fruiting lemma in the form of a short obconical stipes (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CALYX (plural **calyces**), outer envelope of the flower, consisting of free or united sepals (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CALYX is the outer whorl of modified leaves (H.W. Yongken, 2013).

CALYX The outer set of sterile, floral leaves; the green, clasping base of a flower (M. Moore, 1995).

CAMPANULATE, bell-shaped (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CAPILLARY, hair-like, very slender (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CAPITATE, (1) shaped like a head (stigma, etc.); (2) growing in a head-like cluster (flowers of Asteraceae) (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CAPITULUM (or **head**), a dense group of sessile flowers, especially a feature of Asteraceae (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CAPSULE, a dry fruit (consisting of two or more united carpels,) usually splitting into pieces called valves when ripe, or opening at the summit by teeth or pores (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CARPEL or **MEGASPOROPHYLL** is the female organ of reproduction of flowering plants (H.W. Yongken, 2013).

CARPEL, a segment of the female reproductive element of a flower, the lower and swollen portion forms the ovary, inside which the ovules are produced; the upper and narrower portion forms the style and stigma. When there is only one carpel, the terms carpel, pistil, and gynoecium are synonymous; when more than one, the carpels may be free of one another or fused into a single structure (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CAUDEX, a trunk-like axis surrounded by a mantle of roots, for example in *Dicksonia* (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CELL WALL, this is a thin structure in meristematic cells, but it can be very massive and elaborate in mature cells (B.E.S. Gunning, 1996).

CELL, (1) the cavity of the ovary, and especially each cavity of a compound ovary or compound fruit; (2) a pouch or pollen-sac of the anther; (3) one of the minute masses of protoplasm which go to make up the tissue of plants (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CHLOROPLASTS are plastids found in cells exposed to light and contain the green pigment, chlorophyll (H.W. Yongken, 2013).

CHROMATIN, contains the genetic material of the cell, i.e. information in the form of DNA that is passed from parent cell to daughter cell during the multiplication of cells and reproduction of the organism (B.E.S. Gunning, 1996).

CHROMOPLASTS are plastids found in cells independent of their relation to light or darkness and contain the yellow or orange pigment called chromophyll (H.W. Yongken, 2013).

CLASS is formed by special modification of a type (H.W. Yongken, 2013).

COLLATERAL, placed side by side (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

COMPOUND LEAVES are divided into two or more distinct subdivisions called leaflets which may be either sessile or petiolate (H.W. Yongken, 2013).

COMPOUND Leaves that are made up of leaflets, such as pinnate and palmate leaves (M. Moore, 1995).

COMPOUND PISTILS are composed of carpels which have united to form them, and therefore will have just as many cells as carpel (H.W. Yongken, 2013).

COMPOUND, composed of several parts, as a leaf consisting of several leaflets, or a pistil consisting of several carpels; the opposite of simple. A compound panicle has the branches again divided (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

concerned with function. These are the characteristic cells or tissues that do the actual stuff. The importance to us is that parenchymal tissues expend much vital energy in their functions and are less tolerant of a degraded environment than the structural mesenchyme. A congested and impaired organ like the liver of a heavy drinker has so much regular dysfunction that eventually the more tolerant and metabolically less particular mesenchymal cells become more common, and the distressed, overworked, and metabolically compromised parenchymal cells become a minority. The structural cells can multiply with ease in a poor environment, the more delicate functional cells cannot and you end up with the type of cirrhosis sometimes termed mesenchymal invasion disease. The point of this is that the sooner you return an organ or tissue back to the healed state, the more likely you are to have a healthy balance between the structural and functional (M. Moore, 1995).

CORK or suberous tissue is composed of cells of tabular shape, whose walls possess suberized layers (H.W. Yongken, 2013).

COROLLA is the inner floral envelope, usually delicate in texture, and showing more or less brilliant colors and combination of color (H.W. Yongken, 2013).

COROLLA, inner envelope of the flower, consisting of free or united petals (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CRYPTOGAM, plants without stamens, ovaries or seeds; that is the lower groups including the ferns (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

CYTOPLASM, or the foamy, often granular matrix of protoplasm outside of the nucleus (H.W. Yongken, 2013).

DECIDUOUS A plant that drops its leaves in the fall or, in some cases, during drought (M. Moore, 1995).

DECOMPOUND, applied to a compound leaf in which the subdivisions are again compound (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

DELTOID, triangular, with the sides more or less equal (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

DICHOTOMOUS, forking once or several times, each time into two equal branches (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

DICOTYLEDONOUS PLANTS, which have two cotyledon (H.W. Yongken, 2013).

DIFFUSE, spreading horizontally and loosely branched (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

DORSAL, relating to the abaxial side (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

EMBRYO, the young plant while still enclosed in the seed, consisting of the radicle, or base of the future root, one or more cotyledons, or future seed-leaves, and the plumule, or future bud. The radicle always points towards the micropyle (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ENDEMIC, peculiar to a country or district and not native elsewhere (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ENDOCARP, the innermost layer of the pericarp (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ENDODERMIS is the starch sheath layer of cells, constituting the innermost layer of cortex whose radial walls are more or less suberized (H.W. Yongken, 2013).

ENDOPLASMIC RETICULUM, membranous cisternae that ramify through the cytoplasm, occasionally connected to the outer membrane of the nuclear envelope (B.E.S. Gunning, 1996).

EPIDERMIS is the outer covering tissue of a plant and is protective in function (H.W. Yongken, 2013).

EPIPHYTE An air plant, growing on or with other plants but not in any way parasitic (M. Moore, 1995).

EPIPHYTE, one plant growing upon another, without deriving nourishment from it (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

EXOCARP, the combined epicarp and mesocarp of the fruit (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

FAMILY is a group of the same order, related by a common structure (H.W. Yongken, 2013).

FAMILY, a group of genera which resemble each other (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

FERTILE, (A) of flowers: producing seeds; (B) of anthers: containing pollen (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

FLORAL LEAVES or **LEAFY BRACTS**, the upper leaves at the base of the flowering branches. In Rhamnaceae floral leaves are the leaves surrounding a head-like inflorescence, covered with a dense white indumentums (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

FLORAL TUBE, a tube bearing the perianth and stamens, made up of tissue derived from the receptacle and/or perianth and/or stamens (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

FLOWER is a shoot which has undergone a metamorphosis so as to serve as a means for the propagation of the individual (H.W. Yongken, 2013).

FLOWERING PLANTS, or angiosperms, dominate large areas of the land surface and represent the climax of vascular plant evolution (B.G. Bowes, J.D. Mauseth, 2008).

FRUIT, the enlarged ovary and whatever other parts of the flower may adhere to it at the time the seed is ripe (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

GAMETOPHYTE, a plant which bears sexual organs; in ferns usually a small but discrete plant very different from the sporophyte (which is the fern plant); in seed-plants reduced to a microscopic structure within an anther or ovary not recognisable as a discrete plant (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

GENUS (plural **genera**), a group of species which resemble each other (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

GENUS is a still smaller group having the same essential structure (H.W. Yongken, 2013).

GEOGRAPHICAL BOTANY treats of the distribution of plant life on the globe (H.W. Yongken, 2013).

GOLGI BODIES, the units of the Golgi apparatus of the cell. Each Golgi body (= Golgi stack) consists of layered cisternae together with many small vesicles that are involved in traffic to and from the Golgi apparatus and between its constituent cisternae (B.E.S. Gunning, 1996).

GYMNOSPERMS, plants, such as pines, which produce ovules and seeds, but these are not enclosed in a carpel or fruit (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HABIT, the general external appearance of a plant (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HABITAT, the environment in which a plant lives (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HALOPHYTES are the ecological group of plants that grow in saline terrestrial marsh or swamp environments (B.G. Bowes, J.D. Mauseth, 2008).

HERB, a plant which does not develop a woody stem (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HERBACEOUS, green and relatively soft in texture (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HETEROGAMOUS, when the outer flowers in a flowerhead are female or neuter, and the inner ones bisexual or male (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HETEROSPOROUS, with spores of two kinds (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HOMEOPATHY Almost two centuries old, it is a system of medicine in which the treatment of disease (symptom pictures) depends on the administration of minute doses (attenuations) of substances that would, in larger doses, produce the same symptoms as the disease being treated. Homeopaths don't like that «disease» word, preferring to match symptoms, not diagnostic labels. Although by no means harmless, homeopathic doses are devoid of drug toxicity. Many practitioners these days prefer high, almost mythic potencies, sometimes resorting to a virtual «laying on of hands» to attain the alleged remedy. When M.D.s used homeopathy frequently (turn of the century), there were violent battles between low potency advocates and the high potency charismatics. Some preferred low potencies or even mother tinctures (herbs!), which I find quite reasonable (naturally), such as Boericke. Others sought ever higher and higher potencies, tantamount to dropping an Arnica petal in Lake Superior in September and extracting a drop of water at the mouth of the St. Lawrence River the following April. Kent and Clarke were such homeopaths. Philosophically, to me, we are all surrounded in a subtle tide of unimaginably complex pollutants and organochemical recombinants...all low and middle potency homeopathic attenuations...our milieu itself is Mother Nosode...how can we be expected to respond to elegant but unimaginably subtle influences when our very bones radiate a low-potency gray noise. If you have no idea what I am talking about, just consider it a family argument (M. Moore, 1995).

HOMOGAMOUS, when all the flowers in a flowerhead are bisexual (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HOMOSPOROUS, with spores of one kind only (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

HYBRID is a cross-breed of two varieties or species, rarely of two genera (H.W. Yongken, 2013).

HYPANTHIUM, a tube formed by the floral receptacle and bearing the perianth and stamens (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

INDIVIDUAL is a unit of organic life, forming a complete animate existence (H.W. Yongken, 2013).

INFLORESCENCE, arrangement of the flowers on a plant (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

INTERNODE, the part of the stem between two nodes (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

INTERPETIOLAR, of stipules placed between the petioles of opposite leaves (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

LACERATE, irregularly lobed at the margin, as if torn (H. Beentje, 2010).

LACINIATE, cut into slender lobes or drawn-out teeth (H. Beentje, 2010).

LAMINA, expanded part or blade of leaves or petals (H. Beentje, 2010).

LANCEOLATE A leaf that is lance-shaped (M. Moore, 1995).

LATERAL At or on the side, usually from a stem (M. Moore, 1995).

LATEX, milky juice, often sticky

LATICIFEROUS, latex-bearing.

LEAF SCAR, mark on twig or branch where a leaf has fallen off (H. Beentje, 2010).

LEAF SHEATH, part of leaf stalk that envelops the stem and tuns concurrently with it for some distance (H. Beentje, 2010).

LEAF, chloropfyll-bearing lateral outgrowth from stem

LEAFLESS, without leaves (H. Beentje, 2010).

LEAFLET A small leaf that is part of a compound leaf (M. Moore, 1995).

LEAFLET, one (expanded) part of a compound leaf (H. Beentje, 2010).

LECTOTYPE, (in nomenclature) the type chosen by a later author when the protologue indicates no holotype; a lectotype must be chosen from among the specimens mentioned in the protologue (H. Beentje, 2010).

LEGUME, the fruit pod of the Leguminose/Fabaceae, derived from a single carpel, usually (though with many exceptions) opening along a suture into two halves, usually dry.

LEUCOPLASTS are colorless plastids found in the underground portions of a plant and also in seeds, and the egg cell (H.W. Yongken, 2013).

LICHENS are variously colored, usually dry and leathery plants, consisting of symbioses of algae and fungi (H.W. Yongken, 2013).

LIGNIN is a hydrophobic highly cross-linked polymer of phenylpropanoid units evolution (B.G. Bowes, J.D. Mauseth, 2008).

LIGNOTUBER, a woody swelling at the base of the stem (especially in some Proteaceae or species of *Eucalyptus*) (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

LIPID A descriptive term, rather than chemical one, for fats. Broadly, it means true fats (like triglycerides), lipoids (like phospholipids) and sterols (like cholesterol) (M. Moore, 1995).

MEDULLARY RAYS are bands of parenchymatous cells extending radially from the cortex to the pith(primary med. rays) or from a part of the xylem to a part of the phloem (secondary med. rays) (H.W. Yongken, 2013).

MEGASPORANGIUM, sporangium containing megaspores; not readily visible in flowering plants (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

MEGASPORE, spore giving rise to female gametophyte and egg cells (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

MEGASPOROPHYLL, leaf associated with a megasporangium (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

MESOPHYLL, the internal tissues of a leaf (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

MICROSPORANGIUM, sporangium containing microspores (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

MICROSPORE, spore giving rise to male gametophyte and sperm (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

MITOSIS The classic four-phased cellular division of somatic cells, wherein (when the dust settles) two new daughter cells contain full chromosomal information of the parent, complete nuclei, and half the cytoplasm. This is distinct

from cloning (as in the bone morrow) and the chromosome splitting of miosis (ovum and sperm) (M. Moore, 1995).

MONOCOTYLEDONOUS PLANTS, which have one cotyledon (H.W. Yongken, 2013).

MULTIPLE FRUITS are those which are the product of a flower cluster instead of a single flower (H.W. Yongken, 2013).

NAKED, flower without any perianth; seed without a pericarp (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

NODE, the swollen part of the stem from which leaves or branches spring (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

NUCLEAR ENVELOPE, a cisterna (a general term meaning a membrane-bound sac) wrapped around the contents of the nucleus (B.E.S. Gunning, 1996).

NUCLEOLUS, a mass of filaments and particles, largely a sequence of identical repeating units of specialized genetic material together with precursors of ribosomes produced from that genetic information (B.E.S. Gunning, 1996).

NUCLEOPLASM, everything enclosed by the nuclear envelope falls in the category of nucleoplasm, just as objects outside it are constitutents of the cytoplasm (B.E.S. Gunning, 1996).

NUCLEUS, this is bounded by the nuclear envelope and contains genetic material in the form of chromatin, and the nucleolus (or, if more than one, nucleoli in a matrix of nucleoplasm (B.E.S. Gunning, 1996).

NUT, properly a 1-seeded indehiscent fruit, such as the hazel-nut, with a hard dry pericarp (‘shell’), but also used to describe any hard l -seeded nut-like fru it, such as those of Polygonaceae and Cyperaceae (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

OPPOSITE Plant parts, usually leaves, that form pairs at nodes (M. Moore, 1995).

OPPOSITE, (1) of two leaves or other organs rising at the same level, but on opposite sides of the stem; (2) of the members of two concentric floral whorls when they are on the same radii (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011). Or (3) arrangement of plants in groups or ranks according to their resemblances or differences (H.W. Yongken, 2013).

ORDER is a group of the same class, related by a common structure (H.W. Yongken, 2013).

ORGAN is a part of an organism made up of several tissues and capable of performing some special work (H.W. Yongken, 2013).

ORGANISM is a living entity composed of different organs or parts with functions which are separate, but mutually dependent, and essential to the life of the individual (H.W. Yongken, 2013).

OVARY, the lower part of the carpel or pistil, containing the ovules, and finally becoming the fruit(J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PALISADE TISSUE, a tissue of elongate chlorophyll-containing cells with their axes perpendicular to and just below the upper surface of most leaves (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PANICLE A compound flower head that forms a raceme (M. Moore, 1995).

PAPILLAE Small raised bumps or nipples on a tissue surface. Lingual papillae are taste buds (M. Moore, 1995).

PARASITE, a plant growing on another, and deriving its nourishment from the latter (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PARENCHYMAL These are cells in a tissue or tissues in an organ that are particularly hardy in periodic droughts (M. Moore, 1995).

PEDICEL The stem of a flower within a floral cluster (M. Moore, 1995).

PEDUNCLE The stem or stalk of a single flower or a whole floral cluster (M. Moore, 1995).

PELTATE, (1) leaf (or other flat organ, e.g. scales) whose stalk is attached to its under-surface, instead of to the edge; (2) shield-like, pendulous ovule, one hanging from the summit of the ovary. The term suspended is sometimes used when the ovule is attached slightly below the summit (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PENICILLATE, arranged like a tuft of hairs in a paint brush (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PERENNIAL, living for several years (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PERFOLIATE, with the base of the leaf fused round the stem so that the leaf appears to pass through it (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PERICARP, the walls of the fruit, consisting of the ripened ovary. The walls or layers may be more or less fused into one, or they may be easily distinguishable as three: the epicarp, mesocarp, and endocarp. In inferior fruits the concave receptacle remains adherent to the pericarp and forms part of the fruit. Combined epicarp and mesocarp are often called exocarp (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PERISPERM, that part of the albumen in a seed which is outside the embryo-sac (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PETAL, one of the divisions or leaves of the corolla, usually coloured (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PETIOLE A leafstalk or stem, or an unexpanded section (M. Moore, 1995).

PETIOLE, stalk of a leaf (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PETIOLULE, stalk of a leaflet (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PHLOEM is that part of a fibrovascular bundle that contains sieve tubes, phloem cells, and often bast fibres (H.W. Yongken, 2013).

PHOSPHOLIPIDS Fats containing phosphorous, and, along with cholesterol, the primary constituents of cell membranes (M. Moore, 1995).

PHYLLODE, a flat dilated petiole, fulfilling the functions of a leaf, as in many acacias(J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PHYSIOLOGICAL BOTANY explains how the various parts of the plant perform their work of growth, reproduction and the preparation of food for the

support of animal life from substances not adapted to that use (H.W. Yongken, 2013).

PINNAE The leaflets or primary division of a pinnate leaf (M. Moore, 1995).

PINNATE A compound leaf, having the leaflets arranged on each side of the stem (M. Moore, 1995).

PINNATIFID A leaf that is pinnately cleft, but into lobes that do not reach the midrib, and not into separate leaflets (M. Moore, 1995).

PINNULE A division of a pinna (M. Moore, 1995).

PISTILLATE A female flower that has pistils but no stamens (M. Moore, 1995).

PLASMA MEMBRANE, the bounding membrane of the protoplast, normally in close contact with the inner face of the cell wall (B.E.S. Gunning, 1996).

PLASMODESMATA, narrow cytoplasmic channels, bounded by the plasma membrane, which interconnect adjacent protoplasts through the intervening wall (B.E.S. Gunning, 1996).

POLYMORPHIC, occurring in several forms (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

PROTOPLASM is the more or less semi-fluid, viscid, foamy, and granular substance in which life resides (H.W. Yongken, 2013).

RACEME A flowering spike or cluster where the flowers are borne along the peduncle on pedicels of similar length (M. Moore, 1995).

RACEME, an undivided axis or peduncle bearing pedicellate flowers (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

RACEMOSE, arranged in a raceme (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

RADIATE, flowerhead of Asteraceae which has ligulate flowers in the circumference and tubular flowers in the centre (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

RADICAL, arising from the root (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

RAY FLOWERS The margin flowers on a composite head, usually sterile, that resemble single petals. (Example: the white "petals" of a Daisy.) (M. Moore, 1995).

RENIFORM, kidney-shaped (H. Beentje, 2010).

REOPHYTE, plant adapted to fast-flowing water (H. Beentje, 2010).

REPAND, when the margin is uneven or wavy, with shallow undulations not so deep as for sinuate margins (H. Beentje, 2010).

REPTODUCTIVE, concerned in reproduction, in sexual increase (H. Beentje, 2010).

REPTUDUCTION, increase; 1. asexually, from one individual; 2. sexually, from two individuals (H. Beentje, 2010).

RETICULUM, network of veins (H. Beentje, 2010).

RHEOPHYTE is the preferred spelling (H. Beentje, 2010).

RHIZOID, **1.** a hair (often branched) serving as a root; **2.** thread-like rootlets in pteridophytes; **3.** small root- like organs (e.g. coming from the base of the inflorescence in *Utricularia*) (H. Beentje, 2010).

RHIZOME (rootstock), (1) a subterranean stem; (2) in the pteridophytes and seagrasses used in a broader sense to include prostrate creeping and short erect stems below the ground or shortly above it (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

RIBOSOMES, Small particles of RNA and protein lying free in the cytoplasm or else attached to the endoplasmic reticulum (B.E.S. Gunning, 1996).

ROOT BOSS, (in palms) swelling at the base of stem from which the roots arise (H. Beentje, 2010).

ROOT is that part of the plant that grows into or toward the soil, that never develops leaves, rather rarely produces buds, and whose growing apex is covered by a cap (H.W. Yongken, 2013).

ROOT, the descending axis of the plant, developed from the radicle and imbibing water and nourishment through its surface. Adventitious roots arise from stems, most often rhizomes or stolons (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

ROOTSTOCK, that part of an underground stem of a perennial from which the roots arise (e.g. a corm or often a rhizome) (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SAPROPHYTE, a plant obtaining its nutrient from dead organic matter (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SCLEREID, a strongly thickened (lignified) cell, also called a stone-cell (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SCLERENCHYMA is the principal mechanical tissue of plant organs and exists as either sclereids or fibres (B.G. Bowes, J.D. Mauseth, 2008).

SEED, a ripened ovule, consisting usually of two coats, within which is the embryo, with or without albumen (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SEPAL is a leaf or segment of the calyx (M. Moore, 1995).

SIMPLE FRUITS are the result from the ripening of a single pistil in a flower (H.W. Yongken, 2013).

SIMPLE LEAVES are those having a single blade, either sessile or petiolate (H.W. Yongken, 2013).

SPECIES is the smallest group whose structure is constant (H.W. Yongken, 2013).

SPECIES, a division of a genus, each species (group of individual plants) possessing characters which distinguish it from other species of the same genus. Each species bears two names, e.g., *Eucalyptus obliqua,* the first being the generic name, the second the specific one (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SPOROCARP, a thick-walled woody body containing sporangia (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SPOROPHYTE, a plant which bears no sexual organs but only asexual spores (for example the fern plant and, despite appearances, spermatophytes in which the gametophytes which produce the sexual structures are microscopic) (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

STAMEN, male organ of the flower, consisting of a short or long stalk (sometimes wanting) called the filament, which supports the anther. The latter consists of one or two pouches, or cells, containing the minute pollen-grains, by means of which the pistil is fertilized (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

STAMENS or **MICROSPOROPHYLLS** are the male organs of reproduction, and each complete stamen consists of a filament, or stalk, and an anther, or pollen sac, which is the essential portion and contains a powdery substance called pollen (H.W. Yongken, 2013).

STAMENS The male, pollen-producing organs in flowering plants. A staminate flower is only male, with pistillate (female) flowers on the same or different plants. Most flowering plants have both parts on the same flower, although they may mature at different times to avoid self-pollination (M. Moore, 1995).

STEM is that part of the plant axis which bears leaves or modification of leaves and its branches are usually arranged with mathematical regularity (H.W. Yongken, 2013).

STIPULES A leafy appendage formed at the juncture of leaf and main stem (M. Moore, 1995).

STIPULES, two often small appendages growing at the base of the leaf-stalk; they may be free from or attached to the leaf (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

STOLON (**runner**, **sucker**), a basal branch growing just above or just below the surface, rooting at intervals and producing new plants (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

STOLONIFEROUS A plant that tends to form lateral roots, sometimes green and potentially stemming, sometimes blanched and tending to root from the nodes...or both (M. Moore, 1995).

STOMATE, microscopic pores in the outermost layer of cells, with a pair of reniform cells usually surrounding the aperture (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

STROBILUS, a cone containing reproductive structures, as in some pteridophytes and conifers (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SYNCARPOUS, an ovary, pistil, or fruit composed of two or more united carpels (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

SYSTEMATIC BOTANY or **TAXONOMY** considers the classification

TAXON, any group or rank in a biological classification, e.g. family, subfamily, genus, species, subspecies, variety (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

TENDRIL, a filiform organ by which climbing plants cling to some object within reach (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

TONOPLAST, the membrane that bounds a vacuole (B.E.S. Gunning, 1996).

TRACHEIDS are undeveloped ducts having bordered pores and frequently scalariform thickenings (H.W. Yongken, 2013).

TRICHOME, a usually unbranched epidermal outgrowth, e.g. hairs and papillae (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

TRIFOLIATE Having three leaflets in a compound leaf, like a clover (M. Moore, 1995).

TRIPINNATE Thrice pinnately compound leaf (M. Moore, 1995).

TUBER A fleshy, underground part of a stem or root. Example: potato, ***Paeonia*** (M. Moore, 1995).

TUBER, (1) a swollen branch of an underground stem, producing buds, as the potato; (2) a swollen part of a root, acting as a reservoir of nourishment (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

TYPES represent general plans of structure (H.W. Yongken, 2013).

UMBEL A flowering head where the pedicels (individual flower stems) all spring from one point, usually the end of the peduncle. Compound umbels, found in some *Umbelliferae*, have umbels branching from peduncle umbels that themselves are branching from the main stem (M. Moore, 1995).

UNDERSHRUB, a very low growing shrub (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

VARIETY is a peculiarity of Race. Races and varieties are both sub-divisions of species (H.W. Yongken, 2013).

VASCULAR BUNDLES, long tubes or fibres which establish communication between the various parts of a plant. An open vascular bundle is one divided by a layer of cambium, so that the bundle is capable of constant growth; a closed bundle (as in vascular cryptogams and monocotyledons) has no cambium and cannot increase in size (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

VASCULAR COMMISSURE, vascular connection of vein endings (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

WHORL (**VERTICIL**), a set of organs, proceeding from the same node, and arranged in a circle around the axis (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

WHORLED (**VERTICILLATE**), arranged in a whorl (J.P. Jessop, H.R. Toelken & J. Kellermann, 2011).

XEROPHYTE A plant that is adapted to, and needs, dry desert climate or is

XYLEM is complex tissue with two principal roles: the transport of large quantities of water from the root to the shoot in the tracheary elements and the mechanical support of the plant body (B.G. Bowes, J.D. Mauseth, 2008).

XYLEM is that part of a fibrovascular bundle that contains wood cells and fibres. It may also contain tracheae, tracheids, seldom sieve tubes (H.W. Yongken, 2013).

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