ZAPORIZHZHIA STATE MEDICAL UNIVERSITY
DEPARTMENT OF PHARMACOGNOSY, PHARMACOLOGY AND BOTANY
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# PHARMACEUTICAL BOTANY

## ANATOMY AND MORPHOLOGY OF PLANTS

METHODICAL RECOMMENDATIONS
for practical classes for students

Course ____ II ____ Faculty of Pharmacy
group _____
name, surname_____

Zaporizhzhia
2021

**UDC 58(075.8)**
**P 24**

*Manual is approved and recommended for using in learning process by the Central Methodical Commission of Zaporizhzhia State Medical University (record No. ___ from _____, __, 2021).*

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**P 24** **Pharmaceutical Botany.** Anatomy and morphology of plants. Methodical recommendations for practical classes for students / Yu. I. Korniievskyi, V. H. Korniievska, S. V. Panchenko, H. V. Mazulin. – Zaporizhzhia, 2021. – 52 p.

The methodical recommendations aims to prepare pharmaceutical students for practical classes for students

**UDC 58(075.8)**

## Thematic plan for classes

| Topic of the lesson |
|---|
| **I. Plant cell. Plant tissues. Anatomic structure and morphology of the vegetative organs** |
| ***I. Plant cell***<br><br>1. *Plant cell*<br>Study of botanical microtechnology and structure of plant cell. Determination of plastids types and cell sap composition. Determination of types of storage and secretory<br>cell substances. Secondary changes of the cell membrane.<br>• ***Topic control «Plant cell»*** |
| ***II. Plant tissues***<br><br>2. *Plant tissues*<br>Meristematic, covering and excretory tissues. |
| 3. Mechanical, basic and conductive tissues. Phloem and xylem. Types of the conductive bundles<br>• ***Topic control «Plant tissues»*** |
| ***III. Morphology and anatomy structure of plant vegetative organs.***<br>4. Morphology of the vegetative organs. Morphology of the root, shoot and leaf. |
| 5. Anatomy of the axial vegetative organs. The anatomic structure of the root |
| 6. The anatomic structure of the Monocots, Dicots stem and rhizome |
| 7. The anatomic structure of the arboreal stem. Stem of woody dicots and cone-bearing tress. The anatomic structure of the leaf<br>• ***Topic control «Morphology and anatomy structure of plant vegetative organs»*** |
| 8. ***Final control*** **“Plant cell. Plant tissues. Anatomic structure and morphology of the vegetative organs”** |

## Laboratory class № 1

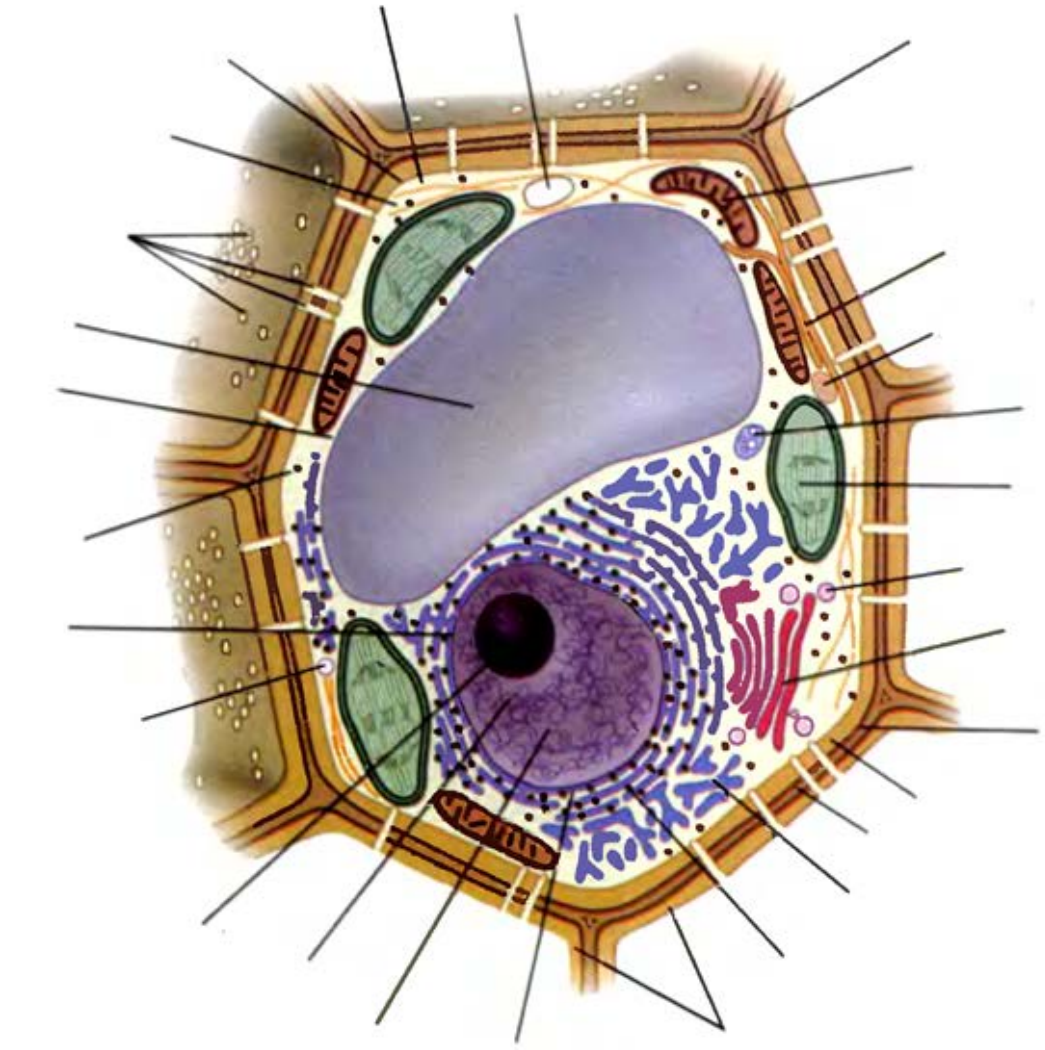
## Plant cell. Structures of cell, which have diagnostic importance including plastid, storage products and mineral crystals

### Individual work

**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. What are the forms and sizes of plant cells?
2. What is the modern notion of plant cell structure and its constituents - protoplasts and their derivatives?
3. Name the biological and physiochemical properties of a plant cell.
4. What components of plant cell have the diagnostic importance for the microscopic analysis of plant objects?
5. What is the structure, chemical composition and importance of plastids? Name the types of plastids?
6. What pigments are typical for plant cells? In which of the cell are they localized? What is their importance and use?
7. What is vacuole, what are its functions? What is the composition of cell sap, its importance and use?
8. Name the storage inclusions of plant cells, their diagnostic signs, chemical composition, principles of their classification, location of accumulation and importance.
9. Where does starch form? What are the types of starch and in what form do they accumulate?
10. What is the structure of starch grains? What is their diagnostic importance and use? Name the quality reactions for starch.
11. What state does inulin accumulate? What is its chemical nature; reactions of visualization and diagnostic importance?
12. What is the form and location of protein accumulation in a plant cell?
13. How do simple aleuronic grains differ from complex ones and with the help of what reactions it is possible to reveal them? Specify their diagnostic importance and use?
14. Where in a plant cell does fatty oil accumulate? By means of what chemical reaction can it be revealed?
15. List the types of crystal inclusions as for their chemical composition and structure. Where do the crystals accumulate? What is their chemical nature; reactions of visualization and diagnostic importance?

**Task 2.** Complete the information and sign picture 1.



Picture 1. Plant cell structure

**Task 3.** Complete the expression: fungal cells differ from plant cells as follows: ...

**Task 4.** Complete the table, make drawings, determine the characteristics for monocotyledons and dicotyledons, write qualitative reactions to crystal inclusions.

**Crystal inclusions**

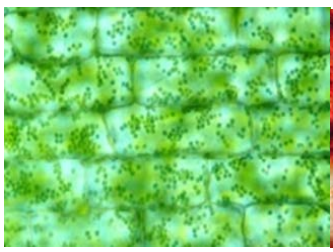
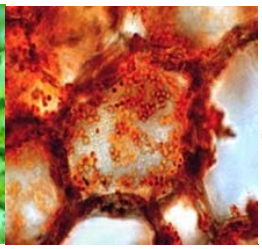
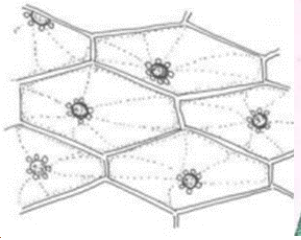
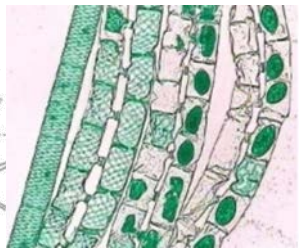
**Calcium oxalate crystals**

**Calcium carbonate crystals**

| | |
|---|---|
| **Rafides (dehydrates)** | **Styloids (dehydrates)** |
| **Friends (dehydrates)** | **Single crystals** |
| **Crystal sand** | |

**Cystolitis**

**Task 5.** Get acquainted with the types of plastids and sign the pictures.

**Task 6**. Fill in the table according to the given example, specify the color of changes.

## Secondary changes of the cell membrane

| The name of the secondary change | Shell properties associated with secondary changes | Cells are alive or dead | Qualitative reactions and their results | |
|---|---|---|---|---|
| | | | **Reagents** | **Visible changes** |
| **Woodening (lignification)** | | The dead | ➢ Phloroglucin with acid<br>➢ Aniline sulfate<br>➢ Chlorine-zinc-iodine<br>➢ Saffron | ➢ Raspberry color<br>➢ Lemon yellow<br>➢ Yellow<br>➢ Red |
| **Suberinization** | | | | |
| **Cutinization** | | | | |

| | | | | |
|---|---|---|---|---|
| **Mineralization** | | | | |
| **Mucus** | | | | |
| **Gum formation** | | | | |

**Task 7.** Choose and mark the correct answer, using the "Collection of test tasks with explanations and illustrations textbook for knowledge control and preparation for the licensing exam Step-1 (Botany)":

1. Green pigments of plants that provide photosynthesis are contained in…
A. chloroplasts
B. amyloplasts
C. chromoplasts
D. proteoplasts
E. mitochondria

2. When studying a plant cell with an electron microscope, structures in the form of a stack of flattened membrane tanks and bubbles were detected. What are organelles?
A. Golgi apparatus
B. endoplasmic reticulum
C. plastids
D. mitochondria
E. microbodies

3. Soluble polysaccharide was detected in the cells of blue-green algae. It is stained with a solution of iodine in brown.
A. glycogen
B. cellulose
S. inulin
D. starch
E. mucus

4. It is established that in plants the synthesis of secondary spare starch occurs in:
A. amyloplasts
B. chloroplasts
C. chromoplasts
D. oleoplasts
E. proteoplasts

5. The cells of the storage parenchyma of the rhizome contain granular inclusions that have many formation centers, around which alternate dark and light layers. What are these grains?
A. complex starches
B. complex aleurone
S. simple starch
D. simple aleurone
E. chlorophyll

6. When examining under a microscope the preparation of potato tubers in the cell shows inclusions, which under the action of Lugol's solution turn blue-violet color. These inclusions:
A. starch grains
B. aleurone grains
C. drops of fatty oil
D. inulin crystals
E. crystals of calcium oxalate

7. The micropreparation was treated with 96% ethanol solution with the formation of spherocrystals.

A. inulin
B. starch
C. protein
D. mucus
E. fats
8. When exposed to a slice of sunflower, the district of Sudan III (IV) appeared yellow-hot color, indicating the presence in this seed:
A. fatty oil
B. protein
C. starch
D. inulin
E. cellulose
9. The result of the histochemical reaction to fatty oils using Sudan district III (IV) is the color (
A. yellow-hot
B. blue color
S. yellow-lemon
D. crimson-red
E. black and blue
10. Microscopic examination of ficus (beech, nettle) in some cells of the epidermis revealed an internal growth of the cell membrane with an accumulation of crystals, which under the action of hydrochloric acid dissolve with the release of carbon dioxide. This structure:
A. cystolitis
B. rafidi
S. druse
D single crystal
E. styloid
11. In the epidermis of the leaf found cells containing cystoliths. The presence of cystolitis is characteristic of plants of the family:
A. nettle
B. cabbage
S. legumes
D. nightshade
E. poppies
12. After the action of chlorine-zinc iodine, the thickened colorless membranes of the cells of the collenchyma became purple. This means that the shell:
A. cellulose
B. lingified
S. cutinized
D. mineralized
E. suberinized
13. After treatment of the micropreparation with a solution of chlorine-zinc-iodine with sulfuric acid, the cell membranes turned yellow. This indicates the presence of…
A. lingin
B. suberin
C. glycogen
D. cutin
14. Treatment of the herbal micropreparation with fluroglucin with concentrated hydrochloric acid resulted in a crimson-red color of cell membranes, indicating the presence of:
A. lignin
B. pectin
C. cellulose
D. hemicellulose
E. suberin
15. Fluroglycine with concentrated sulfuric acid stained crimson-red cell membranes, indicating their…
A. woodiness
B. crunch
S. mucus
D. cutinization
E. mineralization
16. As a result of treatment of the herbal micropreparation of Sudan district III (IV) the cell membranes turned pink, which indicates the presence of…
A. suberin
B. cellulose
S. lingin
D. pectin
E. hemicellulose
17. It is established that depending on the pH of the cell sap, the blue-violet color of the flower petals changes to pink or pale pink, due to the presence of:
A. anthocyanins
B. carotenes
S. xanthophylls
D. phycobilins
E. chlorophyll
18. Microscopic examination of histochemical analysis of purple petals in cell juice revealed a pigment:
A. anthocyanin
B. carotene
C. chlorophyll
D. xanthophyll
E. anthochlor
19. It is established that xanthophylls are yellow-orange plant pigments that give color to the petals, the fruits are localized mostly in:
A. chromoplasts
B. amyloplasts
C. proteoplasts
D. proplastids
E. oleoplasts
20. In overripe juicy fruits there was a destruction of intercellular substance and separation of cells owing to:
A. maceration
B. lingification
C. mineralization

D. mucus
E. humus
21. The nuclei of cells are treated with a drug that destroys the nucleolus, a violation of which process occurred in the cell.
A. formation of ribosomes
B. formation of mitochondria
C. centrosome formation
D. formation of lysosomes
E. formation of the Golgi complex

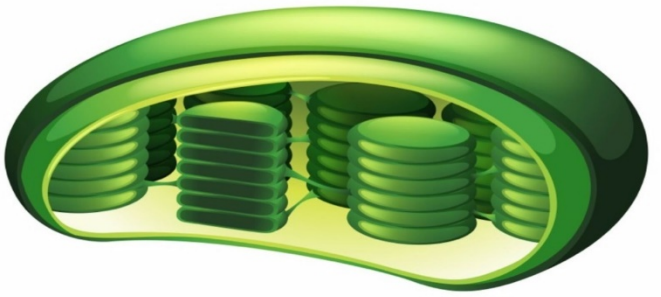
## Laboratory work

### Storage products of cells

**Task 1.** Make a micropreparation from the flesh of the fruit, determine the type of plastids.

Peel a squash, grate it and squeeze the juice. Put on a glass slide in a drop of water, stir and cover with a cover glass. Under a small magnification of the microscope to find individual, freely placed cells, and under a large to consider their shape and chloroplasts in them. Pay attention to the color and shape of chloroplasts.

Draw a few cells with chloroplasts. Mark and sign the pictures. To draw conclusions from the conducted researches.



Picture 1. Chloroplast structure

**Object 2. Chromoplasts and druses in cells of fruit pulp Rosa canina (dog rose).**

Tear slightly the epiderm of the fruit. Take pulp of the fruit with the needle and put it into the drop of water on the slide plate. Put a cover slip. Knock on the cover slip by the blunt end of the needle. Look at the preparation using lense for low and high magnification. You will see roundish parenchimal cell with orange plastids. They are chromoplasts. Grey concretion crystals are druses. Pay attention. Those cells are not connected by a medial lamella, so they are situated separately from each other.

_____
_____
_____
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_____

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_____

**Task 2.** Prepare temporal preparations. Study structure of starch and aleuronic grains and name their types. Conduct qualitative reaction to the starch, reserve protein and fatty oil. Make conclusions.

**Object 3. Tuber of the Solanum tuberosum (potato).**

Put a drop of water on the slide plate. With a fresh cut of the tuber slightly touch several times the drop of water. Put the cover slip on the object. Have a good look at the types of starch grains through the lense for low and higher magnification. Sketch four types of starch grains such as simple excentric and concentric, complex, half-complex grain. Write the names of the components of starch grains. Conduct qualitative reaction to the starch. Without removing the cover slip add a drop of the Lugol's solution on the edge of the cover slip. Look at the result of qualitative reaction through the lense for low magnification. Make up conclusions.

_____
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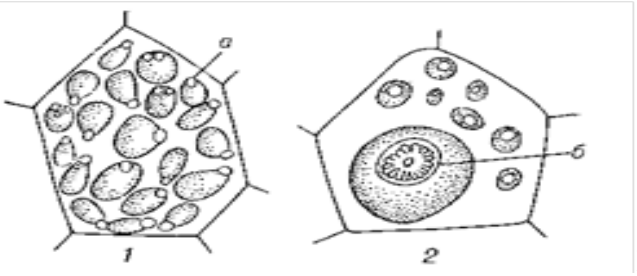
**Task3.** To study the microstructure of simple aleurone grains.

Using a razor, make a thin cross-section of the pea cotyledon, place it in a drop of

Lugol's solution applied to a glass slide, straighten with a needle, cover with a cover glass and examine under a low and high magnification microscope. Find starch (large) and aleurone (small) grains in seed cells. Note that from Lugol's solution, the starch grains turned dark blue and the protein grains turned golden yellow. Mark, sign, describe the results of research. Mark pictures.




1.a- 2.b-

## Laboratory class № 2

## Plant tissues, their classification. Meristematic, covering and excretory tissues.

### Individual work

**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. Plant tissues: definition, classification by origin, morphology, functions, position in organs; diagnostic signs.
2. Generative tissues, or meristems: functions, features of structure, classification, value of meristems.
3. Integumentary tissues: functions and classification.
4. Primary integumentary tissue - epidermis: functions, features of structure.
5. The main (basic) cells of the epidermis: structure, functions, diagnostic features-
-passes: functions, structure, functioning, location, position relative to the surface. --- main types of respiratory tracts, their taxonomic and diagnostic value. Connection of structure and functioning of stomata with ecological factors;
-trichomes: functions, education, diversity, classification, morphological and physiological features, diagnostic value, practical use.
6 The integumentary tissue of the root is an epiblem: formation, structure and functioning.
7. Secondary integumentary tissues - periderm and crust.
8. The main tissues - assimilation, storage, water and air storage: functions, features of the structure.
9. Isolating or secretory structures: functions, classification, diagnostic value:
-exogenous secretory structures (glandular trichomes, nectaries, osmophores, hydatodes): localization, classification, features of structure and functioning, taxonomic and diagnostic value.
-endogenous secretory tissues and structures (idioblasts, secretion containers, passages, channels, milkweeds): formation, placement in organs, classification, functioning, taxonomic and diagnostic value.

**Task 2.** Select the appropriate features for these meristems:

A. Apical meristem-

B. Intercalary meristem-

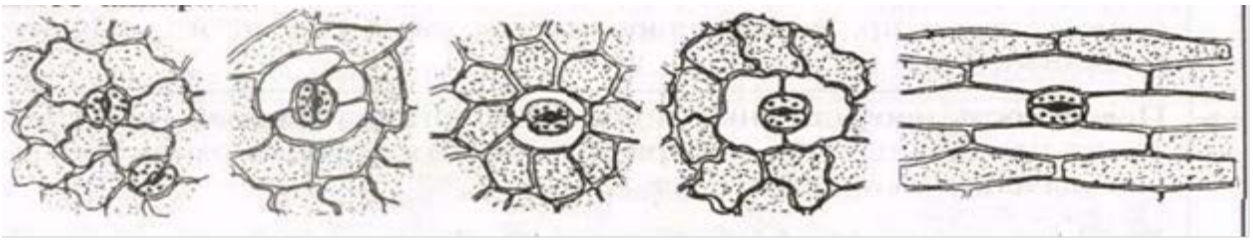
C. Lateral meristem-

D. Traumatic meristem-

1- by origin only primary
2- by origin primary or secondary
3- placed along the organs and their parts
4- is in the cones of growth
5- is placed at the base of internodes, leaves
6- provides apical growth of organs in length
7- provides plug-in growth of organs in length
8- provides growth of axial organs in thickness

**Task 3.** Identify the features that characterize meristem cells:
1 - living, 2 - dead, 3 - always and only prosenchymal, 4 - isodiametric or elongated-spindle-shaped, 5 - thin shells, cellulose-pectin, 6 - thickened shells, woody, 7 - thick cytoplasm, weakly vacuolated, nucleus large, plastids at the stage of proplastids, mitochondria and EPR are poorly developed, 8 - cytoplasm is significantly vacuolated, plastids, mitochondria and EPR are well developed, 9 - ergastic substances are absent, 10 - ergastic substances accumulate.

**Task 4.** Specify the types of respiratory devices shown in the picture.



_____ _____ _____ _____
_____

**Task 5.** Choose and mark the correct answer using the "Online course to prepare for the licensing exam Step-1 (Botany)":

1.Investigated tissue has a large nucleus, thick cytoplasm without vacuoles; numerous mitochondria and ribosomes; poor developed endoplasmic reticulum; no crystals. This is ...
A.meristem
B.endosperm
C.periderm
D.epidermis
E.epiblema

2.Stem thickens due to the function of the …
A.apical meristem
B.lateral meristem
C.traumatic meristem
D.intercalary meristem
E.endodermis

3.Covering tissue has root hairs, have no stoma; and cuticle. This is ...
A.exoderm
B.epidermis
C.periderm
D.velamen
E.epiblema

4.Microscopical examination of a transverse section of root revealed investing tissue consisting of thin-walled, closely joining cells with root fibrille. This tissue is called…
A.epiblem
B.root cap (pileorhiza)
C.epiderm
D.endoderm
E.periderm

5.In the leaf epidermis one can see complexes containing pairwise approximate semilunar cells with chloroplast. These are ...
A.trichomes
B.hydatodes
C.stomas
D.glandules
E.lenticels

6.Leaves of the plants Brassicaceae (Mustard) Family are covered by the epidermis, which has stoma apparatus with three subsidiary cells of different size. These types of stoma apparatus are called ...
A.paracytic
B.diacytic
C.anisocytic
D.anomocytic
E.tetracytic

7.The microscopical study of the leaf epidermis shows that stomas have four subsidiary cells, two of which are lateral and two are polar with regard to the slit. So, the type of stoma apparatus is…

A.diacytic
B.tetracytic
C.anisocytic
D.anomocytic
E.paracytic
8.While the microscopical study of the triennial stem on the cross-section we detected covering tissue, which consists of densely close dead brown cells, with thick cell walls, which impregnate with suberin. This is…
A.epihlema
B.cork
C.epidermis
D.collenchyme
E.chlorenchyma
9.When studying the stem covered with periderm researchers have concluded that gaseous exchange takes place through…
A.stomata
B.hydatodes
C.lenticels
D.pores
E.throughput cells
10.While the microscopical analysis we find complex tissue, which consists of periderm aggregate. This is ...
A.exoderm
B.epidermis
C.epiblema
D.cortex
E.velamen
11.Microscopical examination of the leaf revealed water stomata on its serration. These stomata are for exudation of liquid drop moisture. This process is called
A.transpiration
B.photosynthesis
C.guttation
D.internal secretion
E.gas exchanger
12.In the flower we determine secretory structures, which excrete a sugary solution that attracts pollinators. This is…
A.sticky hair
B.osmophores
C.stinging hair
D.nectaries
E.hydathodes
13.The studied tissue has a large nucleus, a thick cytoplasm without vacuoles; numerous mitochondria and ribosomes; a poor developed endoplasmic reticulum; no crystals. This is …
A.epidermis
B.meristem
C.endosperm
D.periderm
E.epiblema
14.Leaves of the plants Mustard (Brassicaceae) family are covered by the epidermis, which has stoma apparatus with three subsidiary cells of different size. These types of stoma apparatus are called …
A.diacytic
B.paracytic
C.anomocytic
D.anisocytic
E.tetracytic
15.On the cross-section of the Citrus exocarp we discovered large secretory structures without epy exact outline. This is …
A.schizogenous conceptacle
B.cells-idioblast
C.lysigenous conceptacle
D.articulate lacticifer
E.non-articulate lacticifer
16.The microscopical examination of a leaf revealed water stomata on its serration. These stomata are for exudation of liquid drop moisture. This process is called
A.photosynthesis
B.transpiration
C.internal secretion
D.gas exchange
E.guttation
17.While the microscopical analysis of the leaves we discovered structures, which consist of long stalk and small secretory multicellular head. They are …
A.covering hairs
B.stringing hairs
C.hydathodes
D.glandular hairs
E.thorns
18.While the microscopical analysis we find complex tissue, which consists of alive cells with thickened and cutinized external cell walls, stomas, and hairs. This is …
A.epidermis
B.periderm
C.cortex
D.epiblema
E.velamen
19.Cambium is a …
A.covering tissue
B.primary meristem
C.secondary meristem
D.conductive tissue
E.basic tissue
20.It was found that in the rhizome and roots of Inula helenium there are cavities without clear internal boundaries, which are filled with essential oil. It…
A. resin passages
B. schizogenic containers

C. lysigenic containers
D. articulated milkweeds
E. inarticulate milkweeds

21.On the cross section of the bark of the dandelion root are well visible secretory structures in the form of slightly tortuous articular tubes with a dense content. In places, the tubules are connected by lateral branches. Such a structure have…
A. articulated milkweeds with anastomoses
B. articulated milkweeds without anastomoses
C. inarticulate milkweeds
D. inarticulate branched milkweeds

## Laboratory work

**Task 1.** To make a micropreparation of a cross section of a tree plant stem and to study the structure of the periderm.

Make several cross-sections of the elder branch. Choose the thinnest and transfer it to a glass slide in a drop of Sudan III solution. Cover with a cover glass and lighten. Examine under low and high magnification microscope. Find the periderm, lentils, the remnants of the peeling epidermis. Pay attention to the radially arranged rows of rectangular cells of the cork, which under the action of the solution of Sudan III turned orange. Under the cork to find a number of flat cells of phylogeny, divided tangentially into two halves. Under the phylogeny find several rows of oval cells of the feloderma with green chloroplasts.

Draw a fragment of the periderm in cross section and mark its components.

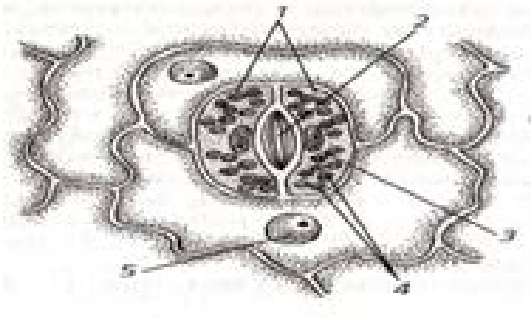
Fill in the table.

### Comparative characteristics of the leaf epidermis of monocotyledonous and dicotyledonous plants

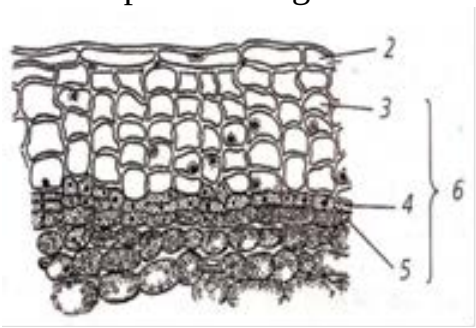
| **Signs** | **Class dicotyledons** | **Class monocotyledons** |
|---|---|---|
| Forms and outlines of epidermal cells | | |
| Types of respiratory system | | |

| | | |
|---|---|---|
| Placement of the airway relative to the longitudinal axis of the leaf | | |
| The presence of the cuticle, trichomes | | |

**Task 2.** Name the cover fabrics shown in the pictures. Sign their components.



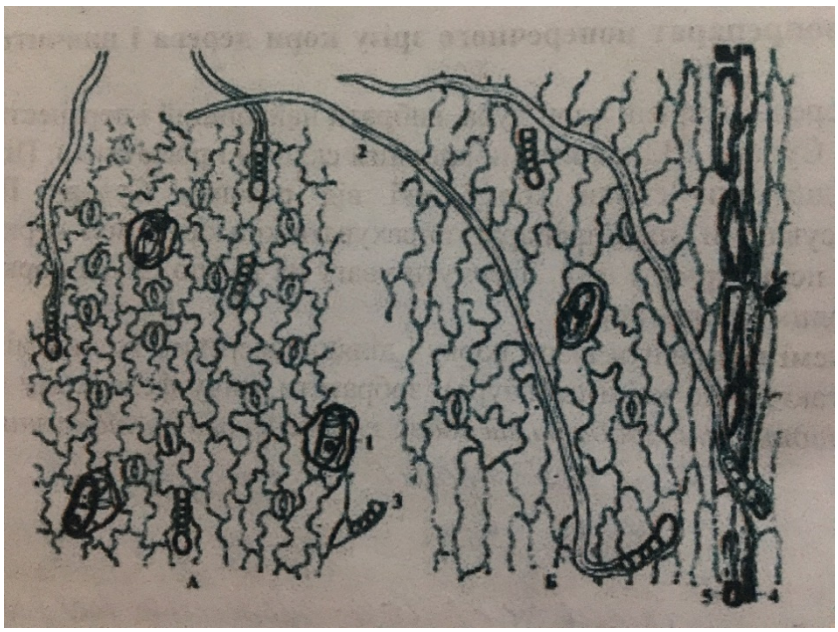
Picture 1.




Picture 2.

Picture1. Primary covering tissue-
Picture 2. Secondary covering tissue-

**Task 3.** To make a surface micropreparation of a member of the aster family of yarrow - Achillea millefolium and to study its microstructure.
From the inflorescence-basket of yarrow with tweezers select a few individual flowers, place them in a drop of water, cover and press with a cover glass.
Make captions to the picture.



A-epidermis of the lower side
B-epidermis of the upper side
1-
2-
3-
4-
5-

## Laboratory class № 3

## Mechanical, basic and conductive tissues. Phloem and xylem. Types of the conductive bundles

### Individual work

**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. Mechanical tissues (collenchyma, sclerenchyma: scleroids, fibers): functions, structure features, location in organs, classification, types, taxonomic and diagnostic value.
2. Conductive tissues: functions, classification.
3. Conductive tissues that provide upward movement of water and minerals - tracheids and vessels: education, structural features, types, taxonomic and diagnostic value.
4. Conductive tissues that provide downward movement of organic matter - sieve-like cells, sieve-like tubes with satellite cells: formation, features of structure and functioning, taxonomic and diagnostic value.
5. Complex tissues - phloem (bast) and xylem (wood): formation, histological composition.
6. Conducting bundles: formation, composition, types, regularity of location in organs, taxonomic and diagnostic value.

**Task 2.** Consider the leading elements of the xylem-vessel with internal thickenings of the cell membrane. Number the appropriate vessel names.

A B C D

1. annular vessels_____

_____

_____

2. spiral vessels _____

_____

_____

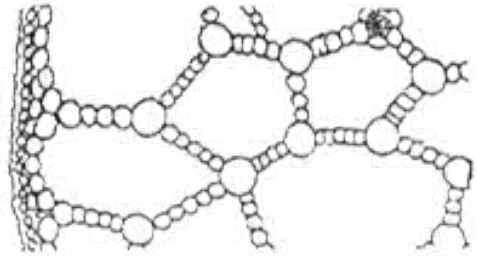
3. ladder vessels_____

_____

_____

4. porous vessels with bordered pores_____

**Task 3.** Consider a fragment of a cross section of the stem of an aquatic plant. Recognize the tissue by morphological features. Make a note to the picture 1



The main tissue of the stem of an aquatic plant

**Task 4.** Fill in the missing information in the table, draw scheme of the bundles.

| **Type** | | **Cambium is / is not present** | **Location of phloem and xylem** | **Scheme** | **Which organs are characteristic** |
|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 |
| Collateral | Closed | there is not | Phloem outside the xylem | | Stems, rhizomes monocotyledonous |
| | … | … | | | Stems, rhizomes and roots of dicotyledons (in the area of conduction) |

| | | | | | |
|---|---|---|---|---|---|
| Bilateral | | … | Phloem outside and inside from the xylem | | Stems, rhizomes of some dicotyledons (in the area of conduction) |
| Concentric | Centro-xylem | there is not | Phloem surrounds the xylem | | Stems, rhizomes of plauns, ferns |
| | … | … | … | | Rhizomes of some monocotyledons |
| Radial | | … | Elements of the phloem between the radial rays of the xylem | | All roots in the suction zone, monocotyledonous roots in the conduction zone |

**Task 5.** Choose and mark the correct answer, using the "Collection of test tasks with explanations and illustrations textbook for knowledge control and preparation for the licensing exam Step-1 (Botany)"

1.While the microscopical analysis of the axis organ between secondary phloem and secondary xylem we find the tissue in the form of the multi-layer ring. Cells are alive, thin-walled, densely closed, flattened, and are situated in radial layers. So,this tissue is…
A. procambium
B. cambium
C. phellogen
D. pericycle
E. phelloderm

2.The cells of leaf mesophyll are elongated, densely close with thin, straight walls and large quantity of chloroplasts, so, chlorenchyma is …
A. spongy
B. palisade
C. folded
D. storage
E. aerenchyma

3.A characteristic feature of strengthening tissues of plants is that such tissues consist essentially of dead cells. However, there exists one type of strengthening tissues consisting of living cells. What contains a living protoplast?
A. sclereids
B. libriform
C. collenchyma
D. perivascular fibers

E. bast fibers
4.While the microscopical analysis of the longitudinal section of the flax (Linum) stem on the periphery we find groups of tightly closed prosenchymatous cells with pointed ends and strongly thickened lamellar cellulose cell walls, which are penetrated with oblique pores. So, this is …
A. wood fibers
B. cortex fibers
C. tracheids
D. bast fibers
E. vessels
5.On the cross-section of the pumpkin (Cucurbita) stem it can be well seen that open conductive bundles have two parts of phloem: inner and outer. These bundles are
A. collateral
B. radial
C. bicollateral
D. concentric with the phloem in the center
E. concentric with the xylem in the center
6.While the microscopic analysis of the rhizome we have found centro-xylem conductive bundles, so the plant belongs to …
A. fern
B. algae
C. dicot
D. monocot
E. gymnospermae
7.Descending stream of organic substances from leaves to all plant organs is provided by …
A. vessels
B. tracheids
C. bast fibers
D. sieve tubers
E. wood fibers
8.In the pulp of leaves (tea, begonia, ivy) sclereids that are dumbbell-shaped or have a form of tubular bones. They are ...
A. macrosclereids
B. threalike sclereids
C. astrosclereids
D. osteosclereides
E. brachysclereids
9.The cells of leaf mesophyll are elongated, densely close with thin, straight walls and large quantity of chloroplasts, so, chlorenchyma is …
A. spongy
B. folded
C. palisade
D. storage
E. aerenchyma
10. When microscopy of the stem of a flowering plant in the phloem identified satellite cells, accompanying ...
A. sieve tubes
B. milk tubes
C. tracheids
D. vessels
E. fibers
11. The trunk of a tree is covered with a tissue that is a set of periderms. This is ...
A. rhizoderm
B. crust
C. mesoderm
D. hypodermis
E. exoderm
12. Studies have shown that the transport of photosynthesis products provide ...
A. vessels and tracheids
B. porous tracheids
C. sieve tubes
D. parenchyma and collenchyma
E. bast fibers
13. On the cross section of the stem of the pumpkin are clearly visible open conductive bundles, which have an outer and inner phloem, which is characteristic of the bundles ...
A. centrifugal
B. centroxylem
C. radial
D. bilateral
E. collateral
14. Cells of loose parenchymal tissue of the stem core are alive, with a thin porous shell. This tissue - ...
A. roof
B. basic
C. leading
D. generative
E. mechanical
15. Experiments have shown that the movement of water and mineral solutions provide ...
A. wood and bast fibers
B. vessels and tracheids
C. sieve tubes and cells-companions
D. endoderm and pericycle
E. angular and lamellar collenchyma
16. For rhizomes of ferns are characterized by conducting bundles, in the center of which is the xylem, and the phloem surrounds it. Such a bunch ...
A. radial
B. centroxylem
C. centrifugal
D. bilateral
E. collateral.
17. In the rhizome of lily of the valley found concentric conductive bundles with a phloem in the center. So the beams ...
A. radial
B. centroxylem
C. centrifugal

D. bilateral
E. collateral
18. It is investigated that the division of root pericycle cells provides the formation of additional buds and ...
A. rhizoderm
B. additional roots
C. trichomes
D. lateral roots
E. root hairs
19. In the study of the cross section of the needles of Scots pine, it was found that the mesophyll consists of cells with chloroplasts and internal loop-like formations of the cell membrane. Mesophilic parenchyma ...
A. water-accumulating, loose
B. ventilating, loose
C. assimilative, folded
D. assimilative, palisade
E. storage, folding
20. Among the elements of the xylem of the studied conductive beam was dominated by tubular articulated structures with spiral thickenings of the shell, ie -
A. tracheids
B. vessels
C. xylem fibers
D. sieve-shaped tubes
E. milk tubes
21. At the microscopic analysis of cross sections of a leaf plate of a Japanese camellia among mesophilic cells huge cells-idioblasts with very strongly and evenly thickened, porous, woody covers are allocated.
These cells are ...
A. trichomes
B. tracheids
C. milkmen
D. scleroids
E. fibers
22. On the cross section of the grassy stem under the epidermis found several layers of living parenchymal cells with cellulose membranes. At the same time the tangential walls of cells are considerably thickened that is characteristic of ...
A. angular collenchyma
B. loose collenchyma
C. lamellar collenchyma
D. storage parenchyma
E. assimilating parenchyma
23. Anatomical and histochemical analysis of the petiole showed that the angular collenchyma is located in areas ...
A. in the mesophile
B. over the veins
C. around the veins
D. in bundles
24. The ascending movement of inorganic substances in conifers provide ...
A. vessels
B. xylem fibers
C. sieve tubes
D. phloem fibers
E. tracheids
25. Microscopy of the stem of a flowering plant revealed a complex tissue, including: sieve-like tubes with cells - satellites, bast fibers, bast parenchyma.
This fabric -…
A. phloem
B. xylem
C. periderm
D. cork
E. crust
26. Living cells are often absent in tissues…
A. integumentary
B. mechanical
C. excretory
D. basic
E. meristems
27. The rhizomes of ferns are characterized by conducting bundles, in the center of which is the xylem, and the phloem surrounds it on all sides. Such a beam - ...
A. concentric centroxylem
B. concentric centrifugal
C. radial
D. collateral
E. bilateral
28. Rhizomes of monocotyledonous plants (lilies of the valley) are characterized by conducting bundles, in which the phloem is located in the center of the bundle, and the xylem surrounds it on all sides. This beam….
A. concentric centrifugal
B. concentric centroxylem
C. bilateral
D. radial
E. collateral
29. Microscopic analysis of rhizome fragments revealed centroxylem conductive bundles, the presence of which may indicate that the plant belongs to ...
A. dicotyledons
B. monocotyledons
C. ferns
D. gymnosperms
E. algae
30. Physiological studies have shown that the transport of photosynthesis products provide ...
A. sieve tubes
B. vessels
C. tracheids
D. parenchyma

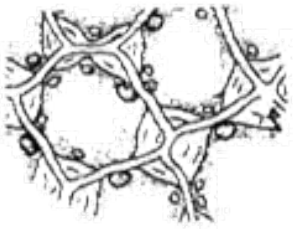
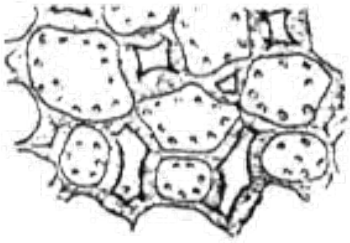
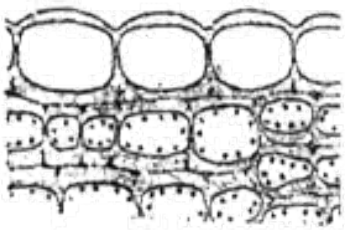
E. bast fibers

31. In the phloem of the stem found groups of tightly closed prosenchymal cells with pointed ends, evenly thickened, layered, partially woody shells. It.

A. bast fibers
B. wood fibers
C. fibrous tracheids
D. fibrous scleroids
E. cells of the collenchyma

## Laboratory work

**Task 1.** Compare the collenchyma of different types, identify common and distinctive features. Specify the name of each type of collenchyma and make a designation.

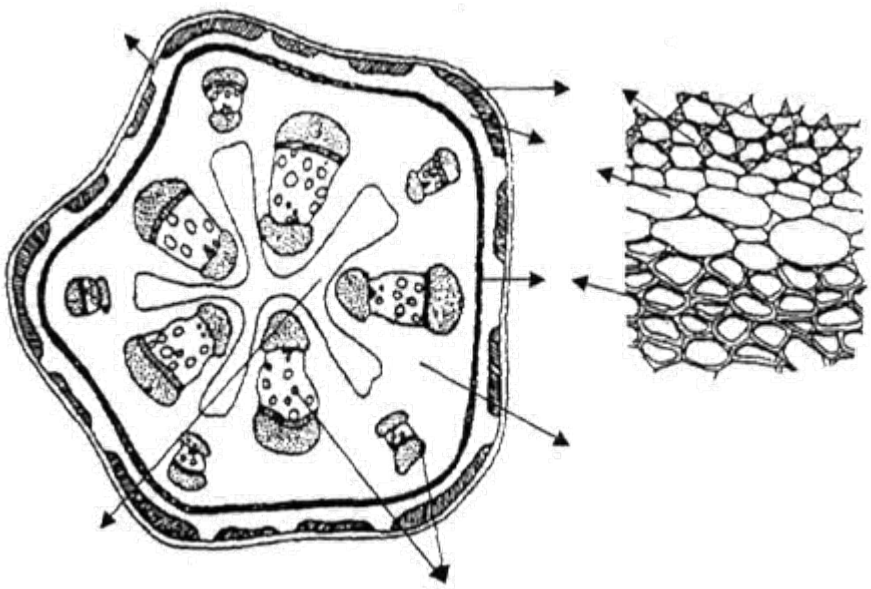




A- _____ B-_____ C-_____

**Task 2.** To make a micropreparation of a cross section of a stalk of a dicotyledonous plant and to study a structure of an open bilateral lateral conducting bunch.

Make a thin slice of pumpkin stalk and make a micropreparation in a solution of chloral hydrate. Illuminate and examine under low magnification microscope. Choose the clearest beam and study its structure under a high magnification microscope. Pay attention to the presence of cambium in the bundle and two sections of the primary phloem at the bottom of the bundle and the secondary - above the cambium. Between them lies the xylem, which is also in the lower part of the primary, and in the part adjacent to the cambium with large vessels - the secondary, formed by the cambium.

Draw a diagram of the anatomical structure of the bilateral open conductive beam. In the figure indicate the cambium, secondary phloem and xylem, primary xylem and phloem. Make appropriate conclusions.



Picture 2. Pumpkin stem scheme.
1 - epidermis;
2 - parenchyma (chlorenchyma) of the cortex;
3 - angular collenchyma;
4 - sclerenchyma;
5 - large and small conductive bundles;
6 - storage parenchyma;
7 - cavity in the core.

## Laboratory class № 4

## Morphology of the vegetative organs. Morphology of the root, shoot and leaf.

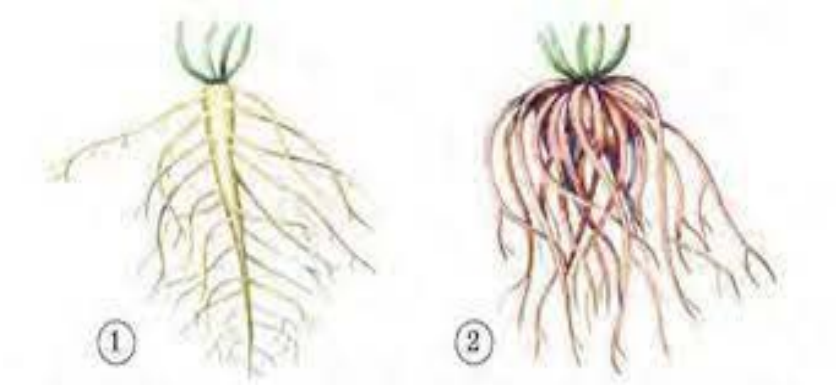
### Individual work

**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. Give the definition of on organ; name the organs of Angiospermous plants.
2. How does a root differ from a stem, what functions does it have?
3. Name the types of roots and specify their origin.
4. What is the root system? What are the types of root system? What classes of plants are they typical of?
5. What are root metamorphoses due to? What are the types of roots according to their specialization?
6. Give the definition of the shoot? What elements does it consist of?
7. Why a bud is named a rudimentary shoot? What are the types of buds?
8. Name and characterize the types of shoot branching.
9. What types of shoots are there according to their position in space, the length of internodes and the shape of the stem cross section? List the aboveground and underground metamorphoses of the shoot. What is their diagnostic importance and practical use?
10. How does a bulb differ from a corm? What features of the shoot are typical for them?
11. Compare the structure of a tuber and a pip. Specify the common and different features of their structure.
12. Why is a rhizome a shoot by its origin, not a root? Give examples of plants which rhizomes are used as medicinal raw material.
13. How do the woody plants differ from grassy ones? Name the vital forms of plants and their features.
14. What are the parts the leaf? Explain the purpose of each of them
15. Name the types of leaf position and the ways of leaf attachment.
16. According to which features are simple leaves with entire lamina characterized?
17. Name the basic forms of the lamina.
18. Name the basic forms of edge, apex and base of the lamina.
19. What types of venation are typical for dicot and monocot plants?
20. Explain, what leaves are called lobed, partite and dissected
21. How do simple dissected leaves differ from compound ones? Name the types of compound leaves.
22. List the metamorphoses of leaves, explain their importance.

### Work in the laboratory

**Task 1.** Specify the types of root systems, make signatures.



Types of the root systems and forms of the roots.

__ 1_____

_____

___2_____

_____

**Task 2.** Specify the metamorphosis of the root and their names.

1 2 3

1_____

2_____

3_____

**Task 3**. Specify the types of branching of the shoot.

**1 -** **2 -** **3 -** **4 -**

**Task 4.** Overground metamorphosis of the shoot and its parts

**A**- :

1-

2 -

**B** –

**C** -

**D- :**

**E -**

**F-**

**G -**

**Task 5.** Underground metamorphosis of the shoot and its parts:

**A-** (*Agropyron repens*)

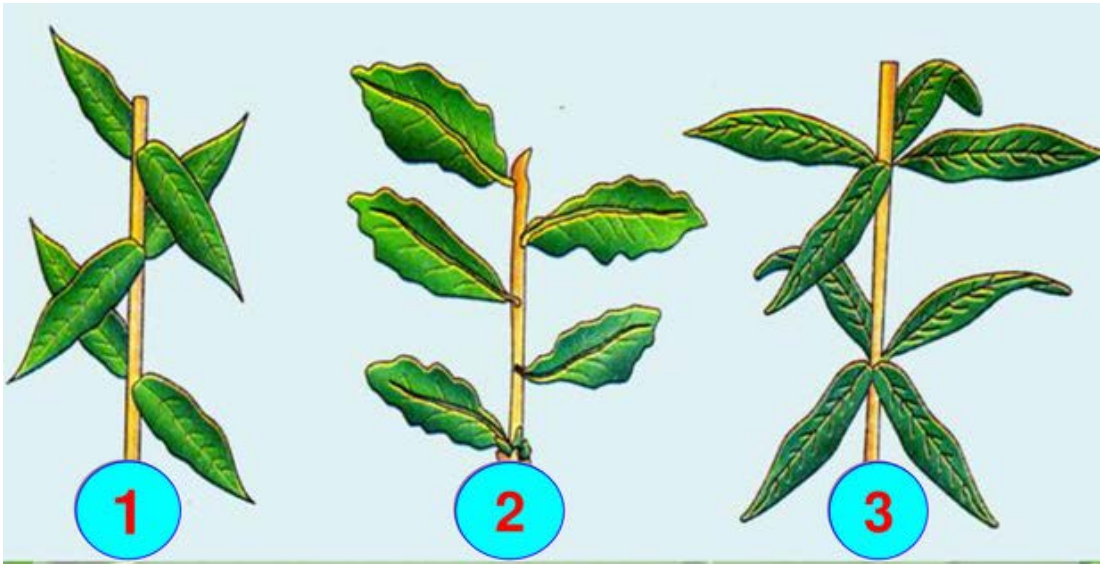
**C-** : 1- (*Allium cepa*)

2- (*Allium sativum*)

**B-** (*Solanum tuberosum*)

**Task 6.**

**Types of phyllotaxis**




**Task 7.** Choose and mark the correct answer, using the "Collection of test tasks with explanations and illustrations textbook for knowledge control and preparation for the licensing exam Step-1 (Botany)"

1.Investigated axial organ without nodes has radial symmetry, positive geotropism, provides mineral nutrition and anchoring in the soil. This organ is …
**A**- stem,
**B**-leaf,
**C**-root,
**D**- rhizome,
**E**-seed.

2. From the given underground organs we choose metamorphoses of the root, namely …
**A**-tubers of potato,
**B**-rhizomes of Convallaria majalis (lily-of-the-valley),
**C**-edible root of carrot,
**D**- bulbs of garlic,
**E**-corms of saffron.

3. A plant has erect stem with only one leaf growing from each node. What phyllotaxy is characteristic of this plant?
**A**-Parallel,
**B**-Verticillate,
**C**-Opposite,
**D**- Alternate,
**E**-Dichotomous.

4. Hop sprouts wind around a support and climb upwards. That means that they are:
**A**- creeping,
**B**-arrect,
**C**-recumbent,
**D**- tenant,
**E**- trailing.

5. Examination of a medicinal plant revealed that its underground organ had nodes, internodes, scale-shaped, gemmae and secondary roots. Therefore, this underground organ is:
**A**-tuber,
**B**-rhizome,
**C**- stolon,
**D**- storage root,
**E**-root bulb.

6. If each node of the stem has more than two leaves, this leaf arrangement is...
**A**-spiral,
**B**-arranged opposite,

**C**-cross-arranged opposite,
**D**-rosette,
**E**-whorled.

7. Examination of a medicinal herb revealed that its leaves were divided down to the base of the leaf blade with segments radiating from a common point in a fan manner. These leaves are:
**A**-pinnatipartite,
**B**-pinnatisected,
**C**-palmatisected,
**D**- palmatipartite,
**E**- palmatilobate.

8. The studying of the main root ontogenesis showed that the root is generated from…
**A**-embryo root of the seed,
**B**-apical meristem,
**C**-pericycle,
**D**- lateral meristem,
**E**- intercalary meristem.

9. Roots of the plants Fabaceae (Legume) Family are determined by the presence of …
**A**-fungus-roots,
**B**- reproductive buds,
**C**- root nodules on the roots,
**D**-corm,
**E**-bulbs.

10. Low stem leafs of the Leonurus cardiaca are divided until the middle of lamina into 3 or 5 parts. This means that they are:
**A**- tripartite-or palmatipartite,
**B**- tripartite- or palmatidissected,
**C**- tripartite- or palmaticompound,
**D**- impari-pinnaticompound,
**E**- impari-pinnatipartite.

11. Hop sprouts wind around a support and climb upwards. That means that they are:
**A**- creeping,
**B**-arrect,
**C**-recumbent,
**D**- tenant,
**E**- trailing.

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14. Examination of a medicinal herb revealed that its leaves were divided down to the base of the leaf blade with segments radiating from a common point in a fan manner. These leaves are:
**A**-pinnatipartite,
**B**-pinnatisected,
**C**-palmatisected,
**D**- palmatipartite,
**E**- palmatilobate.

15. The study object is an undeveloped or embryonic shoot which normally occurs at the tip of a stem or in the axil of a leaf. It has growing point and germinal leaves. Which of the following is described?
A. bud
B. root apex
C. bulb
D. bulbotuber
E. lenticel

## Individual work
## Plan of the leaf description

1. Type of the leaf.
1. Simple leaves with complete leaf blade.
2. Simple leaves with divided leaf blade: *trilobite, tripartite, trisected; palmatilobate, palmatipartite, palmatisected; pinnatilobate; pinatipartite, pinatisected.*
3. Compound leaves: *tricompound, palmately compound, pinnately compound (paripinnately or imparipinnately).*

In case of a compound leaf the leaflets it is composed of are attached to the rachis.

2. Form of the leaf blade.
3. Form of the top, base of the leaf blade, leaf edge.

4. Venation type.
5. The presence of the petiole and its length.
6. The presence or absence of the stipules. Theirs form and development.
7. The presence or absence of the metamorphoses of the leaf and its parts.

Study the given leaves, distinguish their type and describe them according to the plan.

For explain –simple, entire leaf.

**Leaf of tillet (Tilia cordata).**

Petiolate leaf without stipules. Shape of leaf plate is cordate, the top is aculeafe, the base is easily asymmetric, anisopleural and cordate, the edge is irregularly dentate, venation is digitipinnate. Underside is warm grey. In the corners of veins are present bunches of red hairs.

_____
_____
_____

For explain –simple with divided leaf.

**Leaf of absinth (Artemisia vulgaris)**

Petiolate leaf without stipules. Form of outile of the leaf blade – elliptical, pinnatly-parted. Segments is lanceolate, the edge is dentate. Upper side is deep-green, veins is depressed, underside is silvery due to the thick covering with hairs.

_____

For explain – compound leaf.

**Leaf of european wood [wild] strawberry (Fragaria vesca)**

Leaf plate is tricompound with lanceolate stipule, partly the accrete and with the long petiole covered with hairs. The leaflets is sessile, rounded- ovate, top is rounded, the base is wide-wedge-shaped, easily anisopleural, edge is large-toothed-dentate, venation is pinnate. Upper side is deep-green, near without hairs, underside is warm grey-green, fuzzy.

## Laboratory class № 5

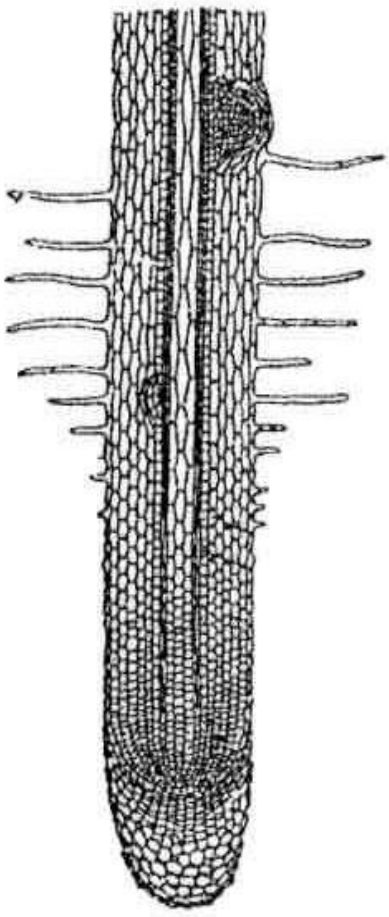
## Anatomy of the axial vegetative organs. The anatomic structure of the root

### Individual work

**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. What zones are allocated in the tip of a root? What is typical for the structure of their cells?
2. What are the features that define belonging of the organ to the root?
3. What rules of structure are typical for a root of a primary structure?
4. How do the roots of dicot and monocot plants differ in the zone of suction, in the zone of conducting?
5. In which zone of a root is the secondary structure observed? What is typical for it? The appearance of what tissues is responsible for the transformations?
6. What is the connection between the function and the anatomic structure of root crops? What types of root crops are there?

**Task 2.** Dot the boundaries of the root zones, mark the root zones. For each zone give the characteristic:



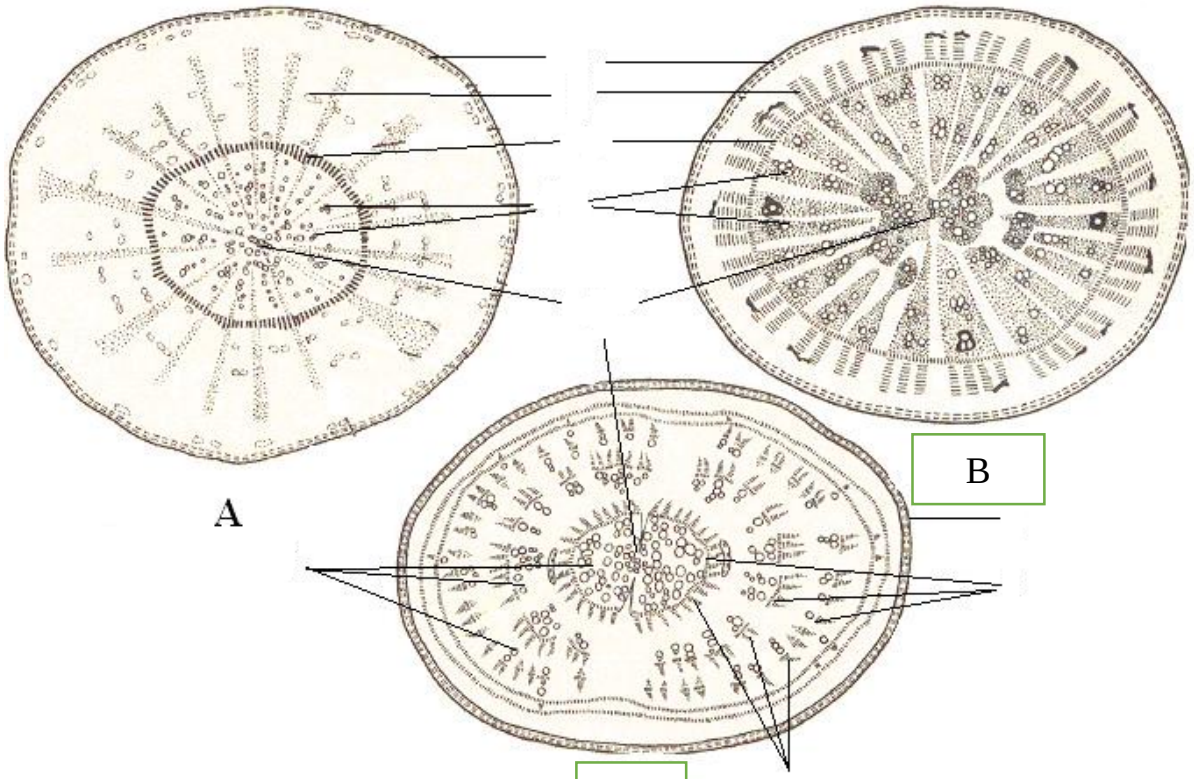
Zone 1_____
_____
_____
_____

Zone 2_____
_____
_____
_____

Zone 3_____
_____
_____
_____

Zone 4_____
_____
_____
_____

**Task 3.** Indicate the types of roots, mark the tissues.




Types of roots:

A - _____

B - _____

C - _____

1 - integumentary tissue (periderm), 2 - secondary phloem, 3 - cambium, 4 - secondary xylem, 5 - remnants of the primary xylem.

## TEST QUESTIONS

**Task 4.** Choose and mark the correct answer, using the "Collection of test tasks with explanations and illustrations textbook for knowledge control and preparation for the licensing exam Step-1 (Botany)":

1. Conductive bundle is discovered on the cross section of the axis organ; its phloem and xylem are situated separately, which take turns radially. So, this type of the bundle is ...
A radial;
B. centroxylem;
C. centrophloem;
D. collateral;
E. bicollateral.

2. While microscopical analysis of the root (region of the absorption) we find one conductive bundle, where tracts xylem and phloem alternate on radius. The type of the bundle is…
A. bicollateral;
B. collateral;

C. centroxylem;
D. centrophlocm;
E. radial.
3. On cross-section of the root we identify: epiblema, exoderm, mesoderm, endoderm and central axial cylinder. So, section is made through the...
A. region of absorption;
B. region of growth;
C. region of anchoring and conducting
D. region of cell division;
E. root cap.
4. While considering the root structure we draw attention on the region which is covered by the tissue with root hairs. This is a region of…

A. root cap;
B. cell division;
C. growth and elongation;
D. anchoring and conductingabsorption;
E. absorption
5. The root of a dicot plant acquires the secondary anatomic structure in the region ...
A. root cap;
B. root hairs;
C. growth and elongation;
D. cell division;
E. anchoring and conducting.
6. On the root section of Helianthus annuus a secondary fascicular structure was found. This means that the section was made in the zone of:
A. absorption;
B. growth and elongation;
C. cell division;
D. fixation and conduction;
E. root cap (pileorhiza).
7. While microscopical study of the root cross-section we determine cover tissue, which consists of thin-walled, tightly closed cells with root hairs. This is ...

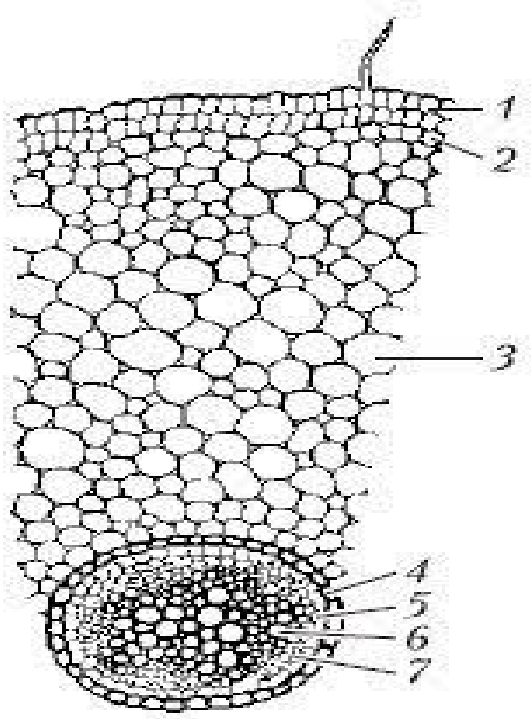
A. epiblema;
B. root cap;
C. periderm;
D.endoderm;
E epiderm
8. While microscopical analysis of the root cross section of a dicot plant made in the absorption region we discovered a line of cells with lenticular suberizing thickening-Casparian strips. These are cells…
A. endoderm;
B. exoderm;
C. mesoderm;
D. pericycle;
E. central cylinder.
9. While microscopical study of the primary cortex of the root we determine under epiblema 3-4 lines of big, multangular, and tightly deed cells with partly suberizcd cell walls. This tissue is ...
A. mesoderm;
B. endoderm;
C. exoderm;
D. epiblema;
E. phellogen.
10. In the root of the primary structure storage substances are reserved in…
A. mesoderm;
B. pericycle;
C. endoderm;
D. central cylinder;
E. exoderm.
11. While microscopical study of the primary cortex of the root, it is ascertained that its main mass is represented by multi-layer, alive, friable parenchyma with starch g rains. This is ...
A. collenchyma;
B. endodermis;
C. exoderm;
D. mesoderm;
E. phloem.

## Laboratory work

**Task 1.** Look at the figers of the cross section of the Monocots root. Look at the tissues using lens for high magnification. Draw a detailed picture of the root. Put the names of the tissues. Make a conclusion.

**Object 1. Primary structure of the monocots root (root of the Iris)**

___- epiblema with the root hairs
___- exoderm
___- mesoderm
___- endoderm
___- pericycle
___- radial bundle:
___- phloem
___- xylem
___ - sclerenchyma




*Covering tissue (_____)*
*Primary cortex (_____)*
*Central cylinder (_____)*

**Conclusions:**

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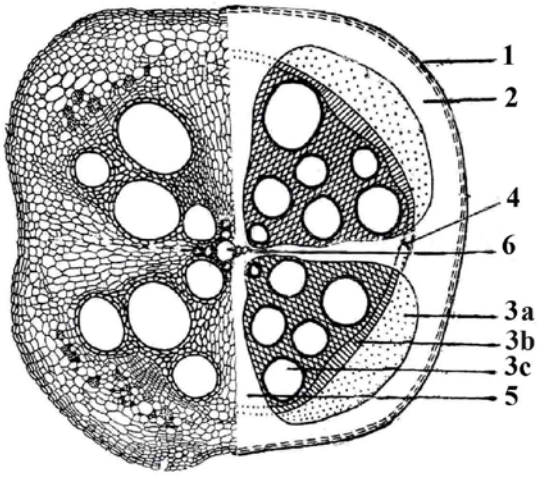
**Task 2.** Look at the figers of the cross section of the Dicotyledons root. Draw a schematic pictures  of the root. Put the names of the tissues. Make a conclusion.

**Object 2. Secondary fascicular structure of the Dicotyledons root (root of the pumpkin)**

- periderm
- cortex parenchyma
- opened collateral conducting bundle:
  - secondary phloem
  - fascicular cambium
  - secondary xylem
- interfascicular cambium
- medullar ray
- primary xylem




**Conclusions:**_____
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## Laboratory class № 6

## The anatomic structure of the Monocots, Dicots stem and rhizome

### Individual work

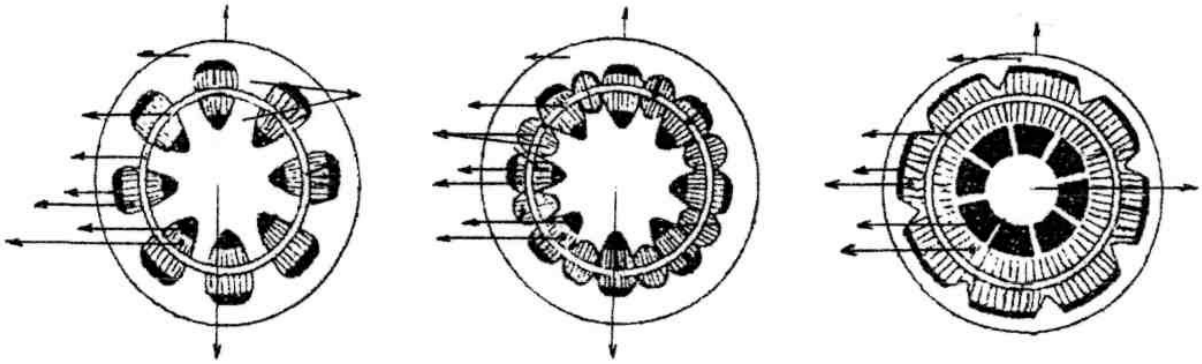
**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. What features of an anatomic structure define the belonging of organs to the stem? What rules of the tissue disposition in the stems of herbaceous plants are there?
2. How does the stem structure of grassy dicot and monocot plants differ?
3. What features define the type of the anatomic structure of the stems of herbaceous dicot plants?
4. What is typical for the anatomic structure of rhizomes unlike stems? How do the rhizomes of monocots differ from dicots?

**Task 2.** Compare the anatomical structure of the stems of herbaceous monocotyledonous and dicotyledonous plants, find differences. Fill in the table

| **Parts, tissues** | **Monocots stem** | **Dicots stem** |
|---|---|---|
| **Covering tissues** | | |
| **The primary cortex of the stems** | | |
| **Axis cylinder**: pericycle and its derivatives, types and location of conductive bundles | | |
| Type of building: primary, secondary, fascicular, nonfascicular and transitional | | |

**Task 3.** Study the diagram of the structure of the stems of herbaceous dicotyledonous plants. Sign the tissues in the picture



A B C

## TEST QUESTIONS

**Task 4.** Choose and mark the correct answer, using the "Collection of test tasks with explanations and illustrations textbook for knowledge control and preparation for the licensing exam Step-1 (Botany)":

1. Phloem of the flowering plant stem has typical histological elements, such as: bast parenchyma, bast fiber, sievetube and also ...
A. wood fibers:
B. without companion cells;
C. companion cells;
D. tracheids;
E. vessel.

2. On the slice of the rhizome in central cylinder we can distinguish closed collateral and centrophloem conductive bundles. It helps to suppose that plant belongs to the class of ...
A. monocots;
B. dicots;
C. ferny;
D. horse-tail;
E. moss.

3. While microscopical study of the rhizome cross-section of the monocot plant we determine that cells of the inner layer of primary cortex have U-shaped thickenings of the cell walls. This tissue is ...
A. pencycle;
B. phellogen;
C. exodenn;
D. endoderm;
E. epiblema.

4. Rhizomes' underground location determines that the most developed tissue is ...
**A**-chlorenchyma,
**B**-storage parenchyma,
**C**-aerenchyma,
**D**-xylem,
**E**-collenchymas.

5. Rhizomes of dicot plants are covered with ...
**A**-epiblema,
**B**-exoderm,
**C**-periderm,
**D**-endoderm,
**E**-epidermis.

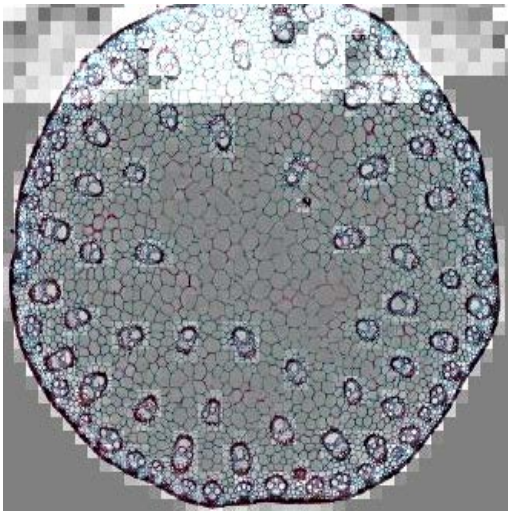
6. Examination of a medicinal plant revealed that its underground organ had nodes, internodes, scals-haped, buds and secondary roots. Therefore, this underground organ is
A. tuber
B. rhizome
C. stolon
D. storage root
E. root bulb

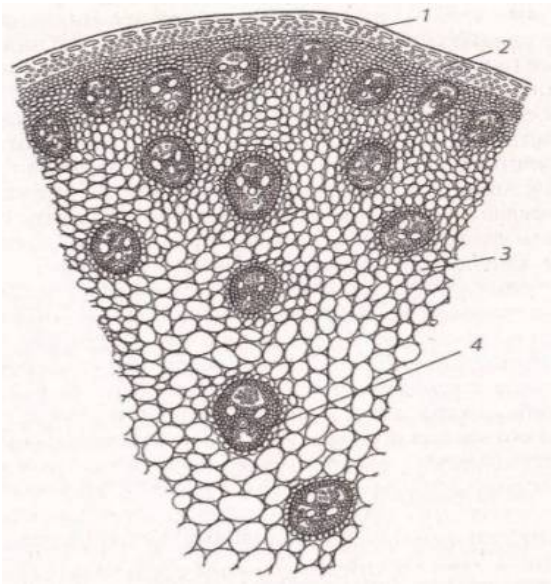
## Laboratory work

**Task 1**. Look at the figers of the cross section of the Monocots stem.
Look at the tissues using lens for high magnification.
Draw a detailed and schematic picture of the bundle. Put the names of the tissues. Make a conclusion.

**Object 1. Primary structure of the monocots stem**
**(stem of the maize)**

1-epidermis
2-pericyclic sclerenchyma
3-closed collateral bundle
  a – sclerenchyma;
  b – phloem;
  c- xylem
4-basic parenchyma of the axled cylinder






**Conclusions:**

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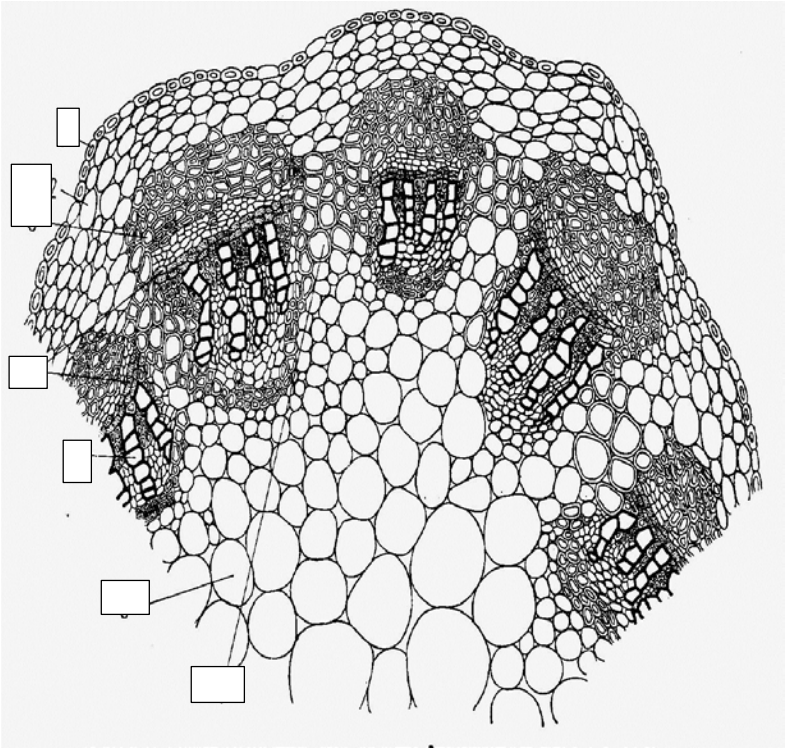
**Task 2.** Look at the figers of the cross section of the Dicotyledons stem. Put the names of the tissues. Make a conclusion.

**Object 2. Secondary structure of the dicots grassy stem (stem of the sunflower)**

1- epidermis with the filaments
2- collenchyma
3- bark parenchyma
4- schisogeneous canale
5- endoderma
6- basic opened collateral bundle:
a- sclerenchyma, b- phloem,
c- fascicular cambium, d- xylem
7- interfascicular cambium
8- additional bandle
9- medullary ray
10- pith



**Conclusions**

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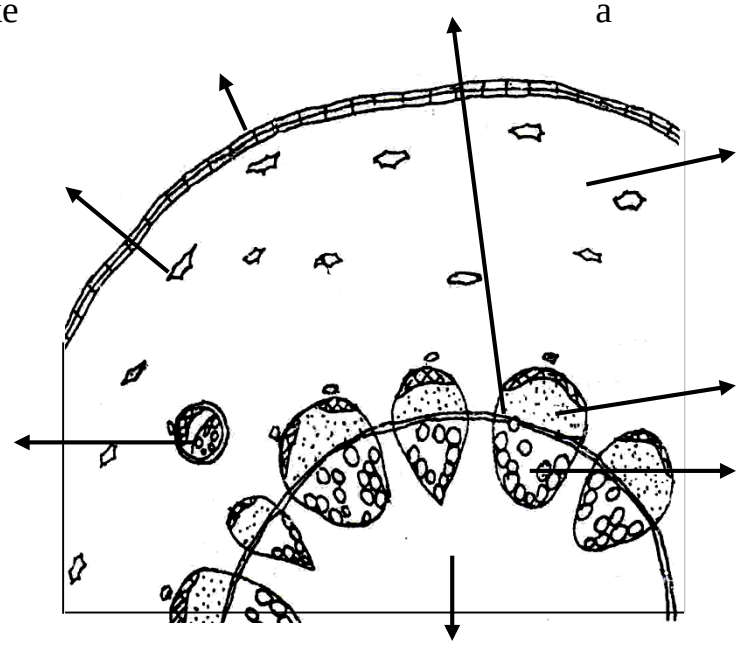
**Task 3.** Look at the figers of the cross section of the dicots rhizome. Put the names of the tissues. Make conclusion**.**




**Object 3**. Structure of the dicots rhizome plant (rhizome of the coltsfoot)

1- periderm
2- storage parenchyma of the primary bark
3- schizogenous duct
4 - opened collateral bundle:
a - clerenchyma
b - phloem
c - vascicular cambium
d - xylem
5 - additional bundle
6 - interfascicular cambium
7 - medullary ray
8 - storage parenchyma of the pith

**Conclusions:**

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## Laboratory class № 7

### The anatomic structure of the arboreal stem. Stem of woody dicots and cone-bearing tress. The anatomic structure of the leaf

### Individual work

**Task 1.** With the help of textbooks, lecture notes and additional literature, study the theoretical material on the following questions:

1. Name the features typical for stems of woody plants. How do the stems of woody plants of angiosperm department differ from the stems of gymnosperm department?
2. Name the diagnostic features that are used for diagnostics of axial organs.
3. Anatomical structure of monocot, dicot and conifers leaves

**Task 2.** Compare the features typical for stems of woody plants. How do the stems of woody plants of angiosperm department differ from the stems of gymnosperm department? Fill in the table

| **Parts tissues** | **Angiosperms** ***Tilia cordata*** | **Gymnosperms - conifers** ***Pinus sylvestris*** |
|---|---|---|
| Covering tissue | periderm with lentisels | periderm without lentisels |
| Primary cortex | | storege parenchyma and schisogenous resin channel (or gum duct) |
| Secondary cortex or phloem | sieve tubers with companion cells, storege parenchyma, bast fibers | |
| Xylem (wood) | | tracheides, gum duct |

## TEST QUESTIONS

**Task 3.** Choose and mark the correct answer, using the "Collection of test tasks with explanations and illustrations textbook for knowledge control and preparation for the licensing exam Step-1 (Botany)":

1.

On the slides of the bark stem of Tillia cordata (small-leaved lime) there were determined dense strands of fiber which are the part of ...

A. pith rays;
B. soft bast;
C. spring xylem;
D. lamellar collenchyma;
E. hard bast

2. While microscopical analysis of the phloem stem we find complex such histological, elements as sieve tubes with companion cells, bast fibers, bast parenchyma. It's typical for ...

A. bryophytes
B. gymnospermous
C. fern
D. angiospermous
E. club mosses

3. The studied stem has gum ducts, in bast there no companion cells and in the wood there no vessels. Spring tracheids carry out the conductive function and autumn tracheids - mechanical function. These anatomy features are typical for ...

A. Tillia (small-leaved lime)
B. Betula (birch)
C. Pinus (pintree)
D. Helianthus (sunflower)
E. Cucurbita (pumpkin)

4. While the microscopical study of the pine leaf we find that layer thick-walled cells, which carry out protective and mechanical function, is situated under the epidermis. This is…

A. hypodermis
B. endodermis
C. crystalliferous
D. collenchyma
E. sclerenchyma

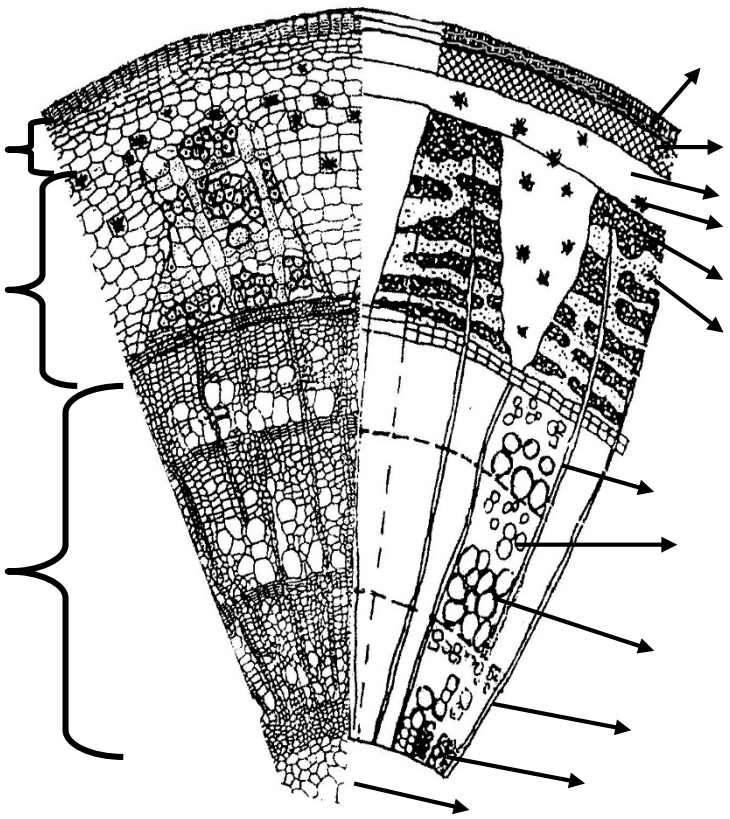
## Laboratory work

**Task 1.** Look of the figers of the cross section of the arboreal angiosperms stem. Look at the tissues using lens for high magnification. Draw a detailed picture of the stems. Put the names of the tissues. Make a conclusion in the table.

**Object 1. Structure of the stem arboreal angiosperms plant (stem of the linden).**

***Schematic and detailed figures of a Lime-tree (Tillia cordata) stem***

1 - periderm
2 - collenchyma
3 - cortex parenchyma with druses
4 - hard bast (bast fibers)
5 - soft bast (sieve tubes with companion cells and the bast parenchyma)
6 - the top of the pith ray
7 - cambium
8 - secondary xylem (wood): *(8 a, b - annual ring)*
9 - primary xylema
10 - pith rays: *a - primary, b - secondary*
11 - pith
Covering tissue (1)
Primary cortex (2-3)
Secondary cortex (4-6)
Axis (or central) cylinder (4-11)



**Conclusions:**

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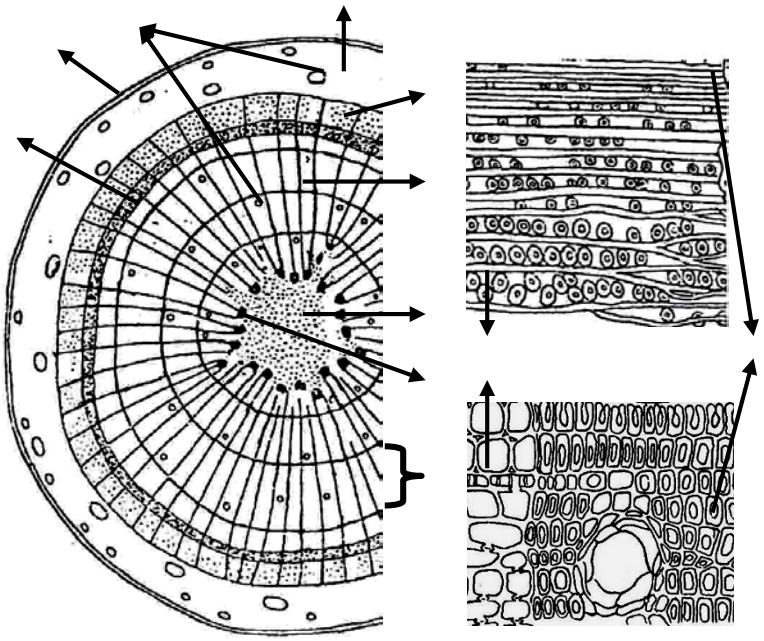
**Task 2.** Look of the figers of the cross section of the arboreal gymnospermous stem. Look at the tissues using lens for high magnification. Draw a detailed picture of the stems. Put the names of the tissues. Make a conclusion in the table.
**Object 2. Structure of the stem arboreal gymnosperms plant (stem of the pine).**

1 - periderm
2 - cortex parenchyma
3 - schisogenous resin channel (or gum duct)
4 - phloem (bast)
5 - cambium
6 - secondary xylem (wood):
*a - spring tracheides;*
*b - autumn tracheides*
*(6 a, b - annual ring)*
7 - pith rays:
*c - primary;*
*d - secondary*
8 - primary xylem
9 - pith



**Conclusions:**

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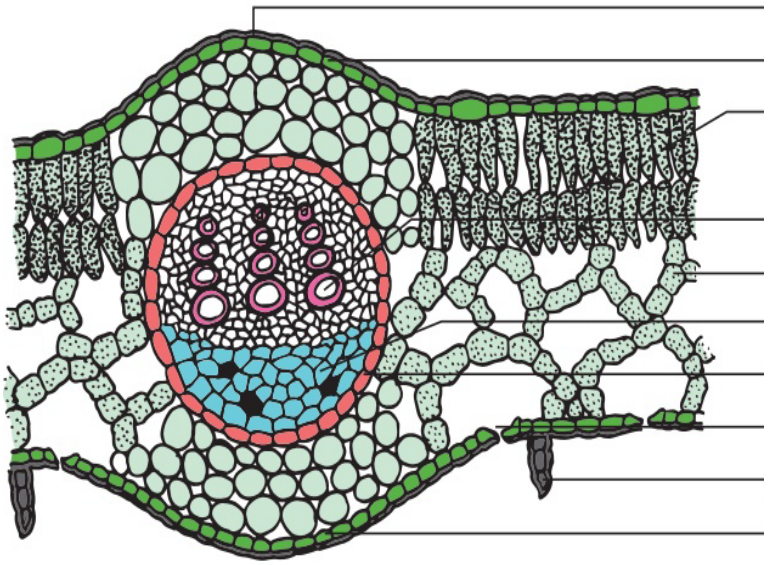
**Task 3.** Look of the figers of the leaf structure of the dorsiventral type. Look at the tissues using lens for high magnification. Draw a detailed picture of the leaft. Put the names of the tissues. Make a conclusion in the table.

**Object 3. The leaf structure of the dorsiventral type (the leaf of camellia)**

1 – upper epidermis;
2 – palisade mesophyll cells;
3 – spongy mesophyll;
4 – cell-idioblast with the druse;
5 – sclereid;
6 – collenchyma;
7 – vascular bundle:
a – sclerenchyma,
b – xylem,
c – phloem;
8 – bundle sheath cell;
9 – lower epidermis;
10 – stoma.



**Conclusions:**

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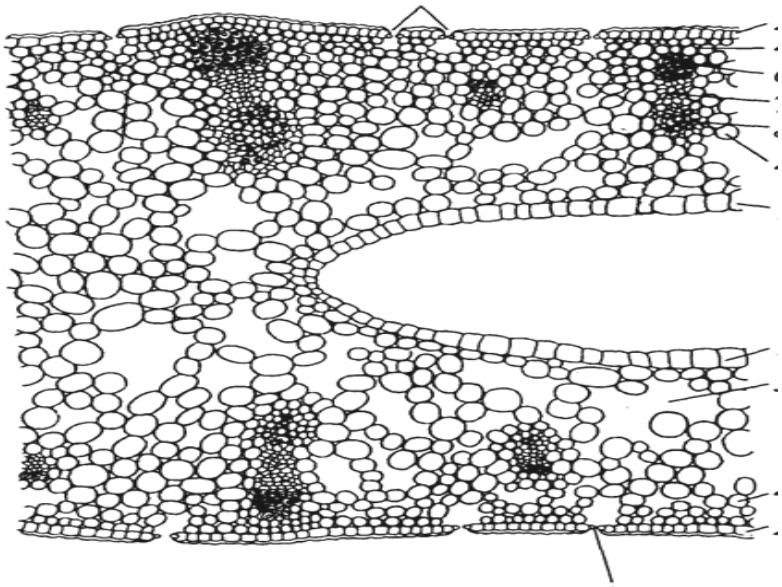
**Task 4.** Look of the figers of the leaf structure of the isolateral type. Look at the tissues using lens for high magnification. Draw a detailed picture of the leaft. Put the names of the tissues. Make a conclusion in the table.

**Object 4. The leaf structure of the isolateral type (the leaf of iris)**

1 – upper epidermis;
2 – spongy mesophyll cells;
3 – air spase;
4 - vascular bundle:
a – sclerenchyma,
b – xylem,
c – phloem;
5 - lower epidermis;
6 - stoma.



**Conclusions:**

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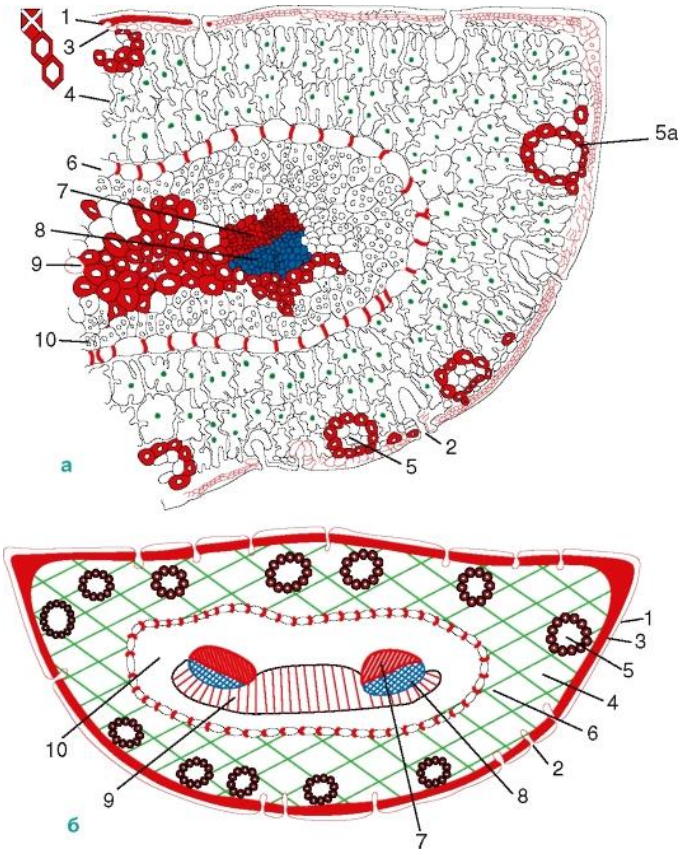
**Task 5.** Look of the figers of the leaf structure of the radial type. Look at the tissues using lens for high magnification. Draw a detailed picture of the leaft. Put the names of the tissues. Make a conclusion in the table.

**Object 5. The leaf structure of the** radial **type (the leaf of pine-tree)**

_____ epidermis;
_____ submerged stoma;
_____ hypodermis;
_____ folded mesophyll;
_____ resin channel (gum duct);
_____ sclerenchymous facing of the resin channel;
_____ endoderm;
_____ vascular bundle;
_____ sclerenchyma;
_____ transfusion tissue.




**Conclusions:**

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**Laboratory class № 8**
***Final control*** **"Plant cell. Plant tissues. Anatomic structure and morphology of the vegetative organs"**

## List literature

### Compulsory:

1. Pharmaceutical botany : textbook / T. M. Gontova, A. H. Serbin, S. M. Marchyshyn et al. ; ed. by T. M. Gontova. – Ternopil : TSMU, 2013. – 380 p.

2. Gullko R. Explonatory dictionary of medical botany / R. Gullko. – Vinnitsya: «Nova Knyha», 2006. – 218 p.

### Supplementary:

1. Приклади тестових завдань. Іспит з іноземної мови професійного спрямування для спеціальності “Фармація” (англійська). URL: https://testcentr.org.ua/banks/pharm/edki-eng-pharm.pdf.

2. Anatomy of plant cells, tissues, organs and their morphology / R. Gullko, O. Baran. – Lviv, 2005. 121 p.

3. Chhatwal G. R. Textbook of Botany / G. R. Chhatwal, M. P. Singh. – New Delhi, 2002. – 813 p.

4. Kingsley R. Stern Introductory Plant Biology / Kingsley R. Stern, Shelley Jansky, James E. Bidlack. – 9th ed. Mc Graw Hill, 2003. – 624 p.

5. Pharmacognosy : textbook for higher school students / V. S. Kyslychen ko, L. V. Upyr, Ya. V. Dyakonova et. al. ; ed. by V. S. Kyslychenko. – Kharkiv : NUPh : Golden Pages, 2011. – 552 p.

6. Sample test questions. Integrated test exam “Krok 1” Pharmacy. URL: https://testcentr.org.ua/banks/pharm/k1-pharm-f-eng-2020.pdf