THE MINISTRY OF HEALTH OF UKRAINE
NATIONAL UNIVERSITY OF PHARMACY

Botany department

Test items

with explains for preparing for licensing examination KROK – 1 “Pharmacy” (BOTANY)

Kharkiv 2016

THE MINISTRY OF HEALTH OF UKRAINE
NATIONAL UNIVERSITY OF PHARMACY

Botany department

Test items

with explains for preparing for licensing examination KROK – 1 “Pharmacy” (BOTANY)

Kharkiv 2016

UDK 581.8
It is recommended by the CMC (central methodical commission) of NATIONAL UNIVERSITY OF PHARMACY (minutes No. 1 from 7.09.2015)

Authors: T. M. Gontova, Ya. S. Kriukowa, V. P. Gaponenko, V.V. Mashtaler, O.S. Mala
Reviewers: *L. A. Toryanik*, Ph.D (Pedagogics), Associate Professor, Head of the department foreign languages NUPh., *T. O. Grinchenko*, professor, Professor of botany department of the Kharkiv National Pedagogical University.

Test items with explains for preparing for license examination KROK-1 “Pharmacy” (BOTANY) / [Gontova T. M., Kriukowa Ya. S., Gaponenko V. P., Mashtaler V. V., Mala O. S.]; under the editorship of Kriukowa Ya. S. – K.: NUPh, 2016. – 93 p.

The textbook represents the tasks from the bank of tests Krok 1 “Pharmacy”. The bank was created by the Testing Center of MEH of Ukraine during 2002-2015. The short explanations are provided to the right answers with illustrations in the textbook. The tests consist of the basis of the task and the resolving part with only one right answer.

Edition purpose:

- ✓ to acquaint students of 2-4 courses with the tests which are used for the current, total control and license examination;
- ✓ to prepare students of 4 courses for license examination «Krok 1»;
- ✓ to help students of 2 and 4 courses with mastering of the program material of the discipline «Pharmaceutical botany».

UDK 581.8
© Gontova T. M., Kriukowa Ya. S., Gaponenko V. P., Mashtaler V. V., Mala O. S.
© NUPh, 2016

Content

Content module 1.

ANATOMY OF THE CELL, TISSUES AND VEGETATIVE ORGANS

Content submodule 1.
Plant cell……..……4

Content submodule 2
Plant tissues…….15

Content submodule 3
Anatomy of the vegetative organs……...30

Content module 2.

MORPHOLOGY OF THE VEGETATIVE AND GENERATIVE ORGANS

Content submodule 1.
Morphology of the vegetative organs……..36

Content submodule 2.
Morphology of the generative organs……..44

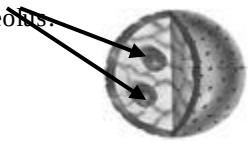
Content module 3.

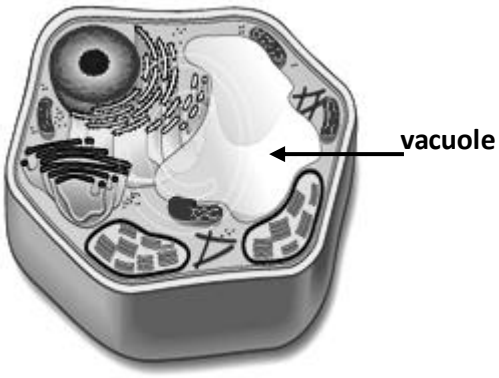
PLANT SYSTEMATIC

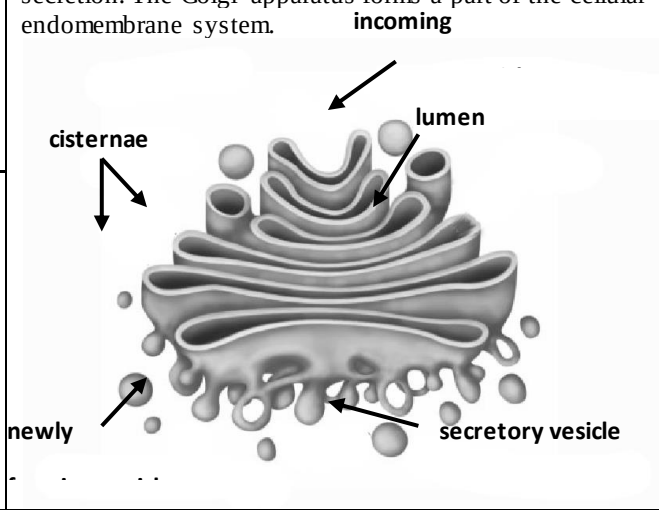
Content submodule 3.
Plant systematic……54
Ecology…… 89
Appendices……...92

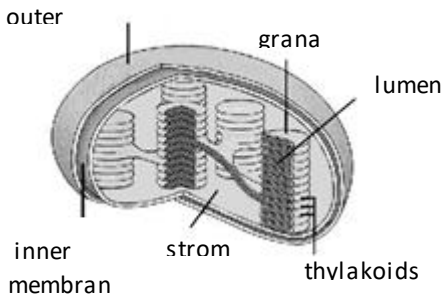
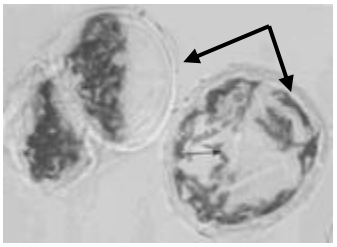
Content module 1.
ANATOMY OF THE CELL, TISSUES AND VEGETATIVE ORGANS

Content submodule 1.
PLANT CELL

Test	Explains
1.1. Cells with large central vacuole, which is confined with tonoplast and filled with the cell sap and can contain crystal inclusions. These cells are typical for … A. **plants** B. animals C. cyanobacteriae D. fungus E. algae	**Plant cells** compared with animal cells have central vacuole, which is confined with tonoplast and filled with cell sap and can contain crystal inclusions starchgrains,aleronic grains.
1.2. Organelles of cytoplasm complex do not include ... A. **nucleus** B. Golgi complex C. endoplasmic reticulum D. mitochondria E. ribosomes	**Nucleus** is an independent and the most important element of any protoplast, which carries hereditary information. The main components of a nucleus are nuclear double membrane envelope with ribosomes, nuclear matrix (mucleoplasm), chromatin and nucleolus. **Cytoplasm organelles** are the Endoplasmic reticulum (ER), ribosomes, Golgi complex, lysosomes, plastids, mitochondria, microtubules 
1.3. Plant cell organelles that carry out a protective function are ... A. **lysosomes** B. ribosomes C. centrosomes D. microtubules E. mitochondria	**Lysosomes** are the cytoplasm organelles that contain numerous enzymes, providing decay of structures and molecules, endo-and exocytosis, and carry out protective function.
1.4. … participate in the formation of vacuoles. A. **bubbles EPR, dictyosomes** B. nucleus C. lysosomes D. ribosomes E. mitochondria\	**Vacuoles** are derivatives of the endoplasmic reticulum and dictyosomes of the Golgi complex. They are limited by vacuolar protein-lipoid membrane, which is called tonoplast. It provides selective capacity. Vacuoles contain cell sap of different composition or crystalline inclusions - aleurone grains (in the seeds) calcium oxalate crystals, etc.

1.5. The cell sap containers in the plant cell are bordered by tonoplast from the cytoplasm, they accumulate water, reserve nutrients and ergastic substances; they also provide the osmolality and cell turgor. They are ... A. **vacuoles** B. nucleus C. mitochondria D. ribosomes E. chloroplasts	
1.6. The membrane, which is adjoin to the vacuole, is called ... A. **tonoplast** B. plasmalemma C. protoplast D. mezoplasma E. karyoplasma	
1.7. The above-membrane component of plant cells includes... A. **cell wall** B. microfilaments C. plazmalemma D. microtubules E. glycocalyx	**The cell wall (shell)** is bordered by the cytoplasmic membrane - plasmolemma and has microfibrillar structure. It consists of water, cellulose, hemicellulose and pectin substances. It provides the cell with its shape and protects the protoplast, participates in the migration of substances. Glycocalyx is a cover of animal cell plasma membrane. **Cellulose** is a membrane polysaccharide (S6N10O5)n of plant cells, a polymer of glucose. The quality reaction on cellulose cell walls involves blue-violet coloring with chloro-zinc-iodine.
1.8. A cellulose monomer is ... A. **glucose** B. galactose C. ribose D. sucrose E. fructose	
1.9. It has been found that soluble polysaccharide is a part of the cyanobacteria and fungi cells. When colored with Lugol's solution, it becomes brown and it is cleaved to glucose phosphate by the enzyme phosphorylase. It is ... A. **glycogen** B. starch C. cellulose D. inulin E. fructose	Polysaccharide **glycogen** (animal starch) is amorphous glucopyranoside $(C_6H_{10}O_5)n$ of fungus, cyanobacteria, animal and human cells. It is hydrolyzed by phosphorylase enzyme to glucose phosphate. The quality reaction involves brown coloring with Lugol's solution.
1.10. Fungus cells, unlike plant cells, accumulate ... A. **glycogen** B. starch C. aleurone D. inulin E. chitin	
1.11. Cytoplasmic filaments, which go through pores of the cell wall, provide interrelation of protoplasts and metabolism between them. They are … A. **plasmodesmas** B. microtubules C. fibrils D. microfilaments E. cytoskeleton	**Plasmodesmas** are thin cytoplasmic filaments, passing through the pores in the cell membrane and providing the interrelation of neighboring cells and protoplasts metabolism between them.
1.12. Cell walls of these plants consist of chitin. It is typical for … A. **fungi** B. arboreal plants C. gymnospermous plants D. higher spore plants E. algae	**Fungus cell wall** is composed of microbe-resistant nitrogenous polysaccharide – chitosan.

1.13. To plant cell organelles that provide concentration, dehydration and induration of substances of endo-and exogenic nature belong the following ones: A. **Golgi complexes** B. lysosomes C. ribosomes D. plastids E. endoplasmic reticulum 	**Golgi complex (apparatus)** - system of tubes, vials, tanks (dictyosomes). Participates in the secretion, the formation of lysosomes and vacuoles, the synthesis of cell wall polysaccharides, renewal and growth membranes.
1.14. While study of a plant cell under microscope it is indicated structures having the form of heap of depressed membrane cisterns and bubbles. This is a … A. **Golgi apparatus** B. endoplasmic reticulum C. plastids D. mitochondrion E. calcium microbody	The **Golgi apparatus** (also **Golgi body** or the **Golgi complex**) is an organelle which found in most eukaryotic cells. It processes and packages proteins after their synthesis and before they make their way to their destination; it is particularly important in the processing of proteins for secretion. The Golgi apparatus forms a part of the cellular endomembrane system.
1.15. During examination of a plant cell under the electron microscope some structures in form of a stack of flattened membrane cisterns and vesicles were found. What organelles are these? **A. Golgi apparatus** B. Endoplasmic reticulum C. Plastids D. Mitochondrions E. Microbodies	
1.16. The cytoplasm of a plant cell is isolated from the cell wall by … A. **plasmolemma** B. tonoplast (vacuolar membrane) C. hyaloplasma D. nucleus envelope E. endoplasmic reticulum	**Plasmolemma** is a thin membrane immediately surrounding the cytoplasm of a cell that restricts the passage of molecules into it.
1.17. It is known that bluish purple petal coloration of a plant under examination varies up to pink or light pink according to pH of cellular fluid of vacuole. It is caused by the presence of: A. **anthocyanins** B. carotins C. phycobilins D. chlorophylls E. xanthophylls	**Anthocyanins** are water-soluble vacuolar pigments that may appear red, purple, violet or blue according to pH. Anthocyanins also act as powerful antioxidants.
1.18. It is known that depending on pH of cellular fluid petal coloration can vary from blue-and-violet to pink and light pink. This is caused by presence of: A. **anthocyanins** B. xanthophylls C. chorophylls D. carotins E. phycobilins	
1.19. Green pigments of the plants are contained in … A. **chlorophylls** B. amyloplasts C. chromoplasts D. proteoplasts E. mitochondria	**Chlorophyll** is the green pigment that absorbs sunlight and uses its energy to synthesise carbohydrates from CO_2 and water. This process is known as ***photosynthesis*** and is the basis for sustaining the life processes of all plants.

1.20 A plant cell differs from the animal one by the presenc of... A. **plastids** B. mitochondria C. Golgi complex D. lysosomes E. nucleus	**Plastids** are specific plant cell organelles, which are covered by two membranes. Plastids are formed from proplastids. Similar to mitochondria, they contain DNA, RNA and ribosomes, They can grow, reproduce, move, change their own structure and composition.
1.21. Plastids are covered by ... A. **double membranes** B. one membrane C. without membrane D. numerous membranes E. three membranes	
1.22. Semi-autonomous organelles of plant cells, which are formed from proplastids, and able to divide, grow and move, like mitochondria, are called ... A. **plastids** B. Golgi vesicles C. chloroplasts D. endoplasmic reticulum E. ribosomes	
1.23. While microscopical study of the plant cell it is established that a well-developed system of the tylakoides is typical for … A. **inner membrane of the chloroplast** B. outer membrane of the chloroplast C. inner membrane of the mitochondria D. inner membrane of the mitochondria E. outer membrane of the proplastid	A **thylakoide** is a inner membrane of the chloroplast. They are the site of the light-dependent reactions of photosynthesis. Thylakoids consist of a thylakoid membrane surrounding a thylakoid lumen. Chloroplast thylakoids contents from grana frequently form grana. Grana are connected by stroma thylakoids, which are join granum stacks together as a single functional compartment. 
1.24. Primary starch is formed in ... A. **chloroplasts** B. leucoplasts C. chromoplasts D. leucoplasts and chloroplasts E. mitochondria	**Primary starch** assimilation in form of fine grains formed in the **chloroplasts**, as a final product of photosynthesis. There is a short time, splits into glucose.
1.25. Secondary reserve starch is formed in the … A. **amyloplasts** B. chloroplasts C. chromoplasts D. oleoplasts E. proteoplasts	**Amyloplasts** are non-pigmented leucoplasts found in some plant cells. They are responsible for the synthesis and storage of starch granules, through the polymerization of glucose.
1.26. Carotin, phyllixanthin and licopin are pigments, which colour petals, fruits and leaves of plants and are accumulated in … A. **chromoplasts** B. amyloplasts C. chloroplasts D. oleoplasts E. proteoplasts	**Chromoplasts** is a pigment plastid found in certain plant cells. Chromoplasts that contain carotenoid pigments impart the red, orange, or yellow colors to various fruit (e.g., tomato fruits), roots (e.g., carrot roots), and petals of the flowers (e.g. tulip). 

1.27. Plastids contain pigments which act as antioxidants and are provitamins A. What are these pigments?
A. **carotinoids**
B. only chlorophylls
C. anthochlor
D. anthocyanins

Carotinoids are tetraterpenoid organic pigments that are naturally occurring in the chloroplasts and chromoplasts of plants As a fat-soluble material, carotinoids are ingested by humans in countless colorful fruits and vegetables. They are important as antioxidants, as well as in their capacity to get converted to essential vitamins.

1.28. Starch is forming in chloroplasts. It is hydrolyzing quickly up to glucose. Such a starch is called …
A. **primary**
B. secondary
C. transient
D. reserve
E. storage

Most of the chloroplast's volume is filled by starch. This is an exceptional state. Usually the **primary** (or assimilation) starch that is produced for the time being is broken down again and transported out of the chloroplast in the form of sugar (transitional starch).

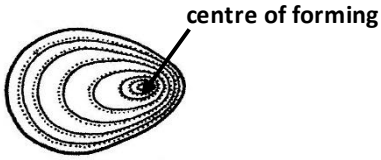
1.29. Microscopic examination of a potato tuber showed some cell inclusions that become blue- violet as affected by Lugol's iodine solution. These inclusions are:
A. **starch granules**
B. aleurone grains
C. inulin crystals
D. drops of fatty oil
E. calcium oxalate crystals

1.30.. In the powder of the rhizomes prevail cells with small granular structures, which have concentric foliation and rima in the center. Lugol's solution colour them in dark blue colour, so these structures are …
A. **simple starch grains**
B. complex starch grains
C. half-complex starch grains
D. simple aleuronic grains
E. complex aleuronic grains

1.31. In the cytoplasm of the plant cells we find storage products. These are grainy structures with numerous centres of forming and alternating dark and light layers around them. Consequently, these are …
A. **complex starch grains**
B. complex aleuronic grains
C. simple starch grains
D. half-complex starch grains
E. simple aleuronic grains

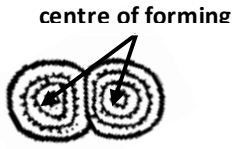
1.32. Starch is discovered by the action Lugol's solution (dark and blue coloration) on the root end. This starch is …
A. **secondary, reserve**
B. primary, anabolic
C. secondary, transitional
D. primary, preserve
E. secondary, reserve

Reserve starch accumulates in the storage tissues of rhizomes, tubers, seeds and other parts of the plant in the form of starch grains. They are formed in amyloplasts by initiation of a formative centre and lamination around its dark (day) and light (night) layers of starch. There are different types of starch grains such as simple concentric, simple eccentric, complex and half-complex. **Starch grains** with one center of forming are called **simple**. Concentric starch grains have center of forming, which coincide with geometrical center. Simple eccentric starch grains have center of forming, which does not coincide with geometrical center.



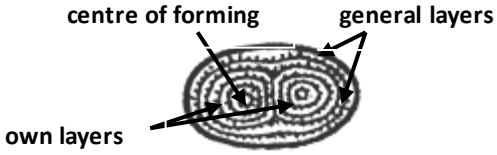
simple starch grain

Complex starch grains have two and more center of forming with their own layers.



complex starch grain

Half-complex starch grains have several center of forming with own and general layers.



half-complex starch grain

Iodine **solution** (Lugol's solution) is used to test for starch. A dark blue color indicates the presence of starch.

In cells of the root cap (or end) there is defensive **secondary starch**, which influence on positive geotropism – progression of the root in the depths of the soil.

1.33. Thin cuts of *Inula helenium* roots are put into ethyl alcohol 96%. While microscopical analysis of the cuts we found out spherocrystals. This indicates the presence of…

A. **inulin**
B. starch
C. protein
D. mucus
E. fat

Taraxacum officinale
dandelion

Inulin is a soluble polysaccharide that contains in the cell sap of some plants of the *Asteraceae* Family (e.g. dandelion). Under the action of alcohol inulin forms spherocrystals (see Fig. and Photo).

Inulin is recommended sometimes for diabetics; it has a mildly sweet taste, and is filling like starchy foods, but because it is not absorbed, it does not affect blood sugar levels.

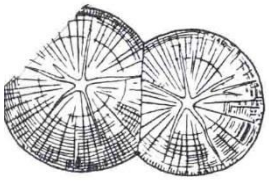
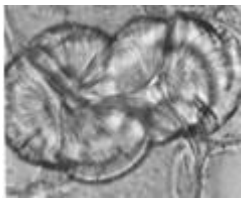


Fig.



Foto

1.34. Among the groups of biologically active substances listed below there is a compound of reserve nutrients of cell sap. It is ...

A. **inulin**
B. coumarins
C. saponins
D. flavonoids
E. terpenoids

1.35. According to its chemical nature and significance, inulin is a ...

A. **carbohydrate**
B. lipoid
C. storage protein
D. mineral substance
E. excretory product

1.36. While microscopical studied of the seeds we find aleuronic grains, which are complex, because they consist of …

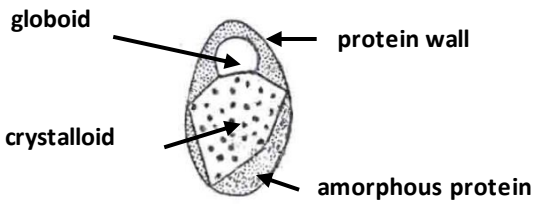
A. **crystalloid, amorphous protein, globoid**
B. nucleus, vacuoles, globoid
C. globoid, vacuoles, crystalloid
D. vacuoles, amorphous protein, globoid
E. nucleus, amorphous protein, crystalloid

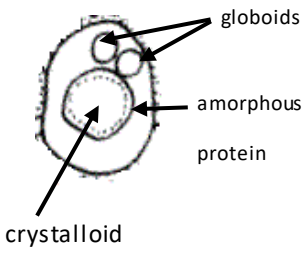
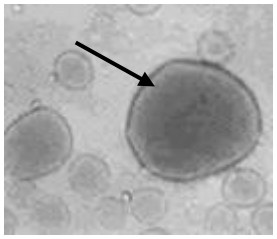
1.37. Under the action of concentrated nitric acid and heating the proteins is dyed in …

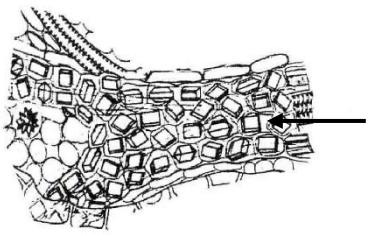
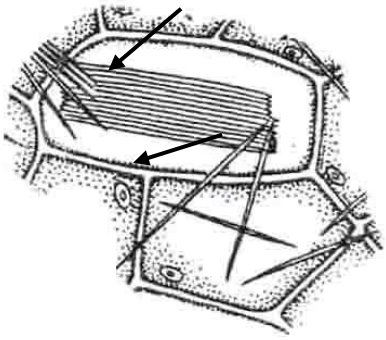
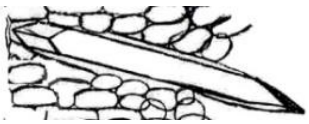
A. **bright yellow**
B. red
C. orange
D. violet
E. blue

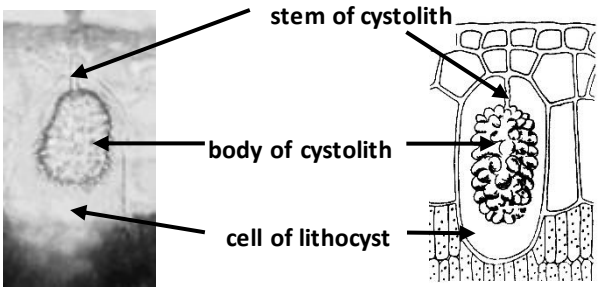
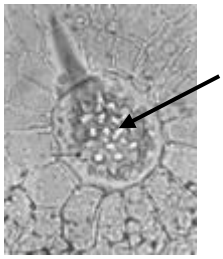
Simple aleuronic grains consists of protein wall, amorphous protein and, sometimes, globoid. In **complex grains** besides it, a protein crystalline hydrate – crystalloid is formed. The ability to form crystalloid in the aleuronic grain is peculiar to definite plants.

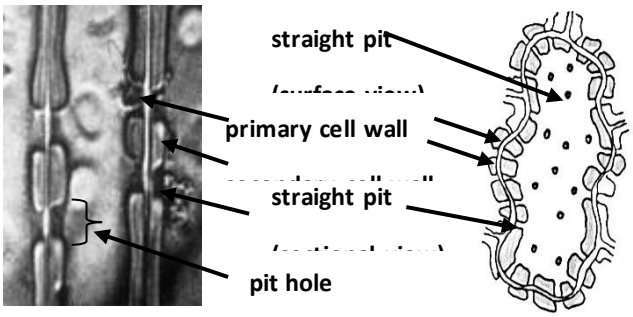
Under action of Lugol's reagent protein is dyed in yellow colour. Nitric acid reacts with proteins to form yellow nitrated products.

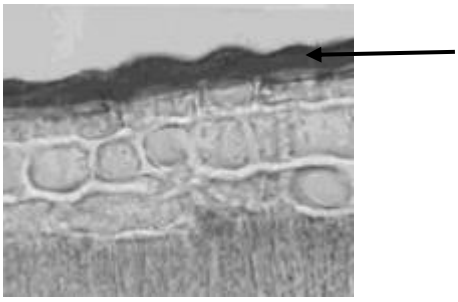


1.38. Solid inclusions containing proteins were found in cells of castor seeds during their microscopic examination. They are ... A. **aleuronic grains** B. starch grains C. cystolith D. styloids E. raphides	As reserve nutrients, plants accumulate simple proteins. They are proteins in the form of **aleuronic (protein) grains**. They are deposited mainly in the seed storage tissues as a result of vacuole drying. In addition to amorphous protein and globoid (phytin, salt**), complex aleuronic grains** contain one or more **crystalloids** - protein crystalline hydrates. Aleuronic grains in the seeds of some plants (*anise, grape*) contain calcium oxalate crystals
1.39. Aleuronic grains accumulate… A. **proteins** B. carbohydrate C. mineral substances D. lipids E. excretory substances	Plants accumulate storage substances, such as simple proteins or aleuronic **(protein)** grains. They are deposited mainly in the storage tissues of seeds as a result of vacuole drying. In addition to amorphous protein and globoid (it contains phytin, salts), **complex aleurone grains** contain one or more crystalloids – protein crystalline hydrates. In seeds of same plants (anise, grapes), aleurone grains contain crystals of calcium oxalate.
1.40. Inclusions of a plant cell that contain crystalloids, globoids or crystals of calcium oxalate, are … A. **complex aleuronic grains** B. half-complex starch grains C. inulin D. solid fats E. complex starch grains	
1.41. Histochemical test for fixed oils with sudan III results in the following stain colour: **A. pink and orange** B. blue and violet C. lemon-yellow D. raspberry-red E. black and purple	**Fatty oil** is the basic for storage product, which is formed by means of oleoplasts. Fatty oils are concentrated in the seeds. They are very power-consuming storage substances. Under action of Sudan III fatty oil is dyed in pink and orange colour. 
1.42. The influence on the slide of sunflower (*Helianthus annuus)* seed by the solution of Sudan III, pink-orange coloration appeared, it is the evidence of the presence of the … in the seed. A. **fatty oil** B. protein C. starch D. inulin E. cellulose	
1.43 … belongs to reserve liquid inclusions of a plant cell. A. **fatty oil** B. primary starch C. secondary starch D. transient starch E. aleuronic grains	**Fatty oil** is liquid storage product, which is accumulated in the cytoplasm in the form of tiny droplets. Under action of Sudan III, lipids and lipoids are colored pink and orange.
1.44. Organic compounds of plant cell of non-carbohydrate nature include ... A. **waxes** B. pectin substances C. inulin D. fiber E. mucus	**Waxes** are esters of higher fatty acids and alcohols, sometimes in mixtures with free fatty acids, paraffins. Waxy substances coat leaves, pericarps, protect from evaporation and negative effects of gases, as well as from various damages.

1.45. While microscopical study of leaf we determined the presence of the crystalline facing which accompanies … A. **the central vein** B. the columnar mesophyll C. the spongy mesophyll D. the edge of leaf blade E. supporting idioblasts	 The crystals of oxalate calcium can accumulate in cells leaves veins forming to **crystalline facing**.
1.46. Druses are … A. **growths of pyramidal crystals** B. aggregate of single crystals C. aggregate of crystal sand D. aggregate of acicular crystals E. aggregate of cystoliths\	**Druses** (calcium oxalate dehydrates) are stellar pyramidal crystal growths. Crystals commonly occupy a dead idioblast cell.
1.47. With the help of microscopic and histochemical methods in the cells of solomon's seal (*Polygonatum officinalis)* rhizome one can determined raphids, which are … A **needle-shaped crystals of calcium oxalate** B star-shaped crystals of calcium oxalate C. single crystals of calcium oxalate D. grape-shaped crystals of calcium carbonate E. needle-shaped crystals of calcium carbonate	**Raphides** (dehydrate) are needle-shaped crystals of the calcium oxalate. They are situated, as usually, in the form of bunch and fall out of the cell when it is damaged. Raphids are diagnostic features of the Monocots plants (e.g. lily). Under the action of hydrochloric acid calcium oxalate salts dissolve without gas isolation. $CaC_2O_4 + 2HCl \rightarrow CaCl_2 + H_2C_2O_4$ 
1.48. On superficial preparation of lily-of-the-valley (*Convallaria majalis*) leaf bunches of needle-shaped crystals are distinguishable in cells-idioblasts of the mesophyll. These are … A. **raphides** B. cells of cystoliths C. druses D. singles crystals E. stilloids	
1.49. According to the morphological features the herbaceous plant is lily-of-the-valley *(Convallaria majalis)* to confirm this additionally it was made a microscopic analysis of a leaf and searching of crystalline inclusions of… A. **raphids** B. singl crystals C. druse D. styloid E. crystal sand	
1.50. Monocot plants have needle-shaped crystals of oxalate calcium which are collected in packs. These are … A. **raphids** B. druse C. styloids D. twin crystals E. crystal sand	
1.51. Single elongated prismatic crystals with pointed ends were found in leaf cells of a monocot plant. They are … A. **styloids** B. raphids C. druse D. crystal sand E. cystolith	**Styloids** are elongated, narrow, prismatic crystals with pointed ends, which are located in an idioblast cell. 

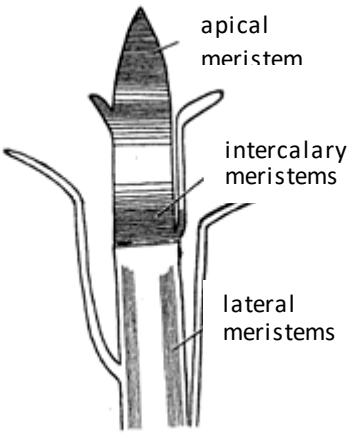
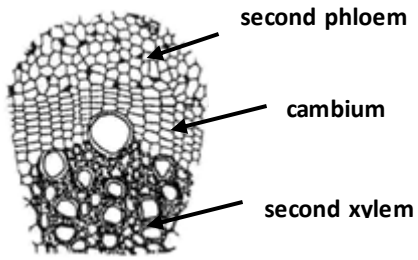
1.52. Investigated plant is determined as *Urtica dioica* on the base of morphological diagnostic features. It is verified while the microscopical study by the present of the … A. **cystolith** B. druses C. raphids D. styloids E. single crystals	**Cystolith** is an internal growth of cell membrane where the salt of calcium carbonate and silica are layered. It has an appearance of hilly body roundish or elongated form. They are situated in epidermis cells or in the base of hair. Under the action of hydrochloric acid calcium oxalate salts dissolve without gas isolation, however calcium carbonate salts dissolve and gas – carbonic acid exudes.
1.53. By microscopic study of fig leaf (*Ficus*) in some epidermal cells the inner outgrowth of the cell wall was observed with accumulation of crystals that under the action of hydrochloric acid are soluble with evolving of carbonic gas. This structure is … A. **cystolith** B. single crystal C. druse D. styloid E. raphide	$Ca\,CO_3 + 2HCl = CaCl_2 + H_2CO_3$ $\downarrow CO_2\uparrow \quad \downarrow H_2O$
1.54. Examination of the leaf epidermis revealed cells containing cystoliths. Presence of cystoliths is typical for plants of the following family: **A. Urticaceae** B. Brassicaceae C. Fabaceae D. Solanaceae E. Papaveraceae	 cystolith in epidermis c
1.55. We find aciniform concretions of the calcium carbonate among the products of life activity of the protoplast, i.e. … A. **cystolith** B. single crystals C. raphids D. styloids E. druses	 cystolith of the *Urtica dioica* (nettle)
1.56. While we do microscopical analysis of the beech wood we discover crystals, which under the action of hydrochloric acid dissolve with gas isolation. So these are crystals of … A. **calcium carbonate** B. calcium oxalate C. calcium potassium D. suberin E. inulin	
1.57. Under the action of chlorine-zinc-iodine the thickened, colourless cell walls of collenchymas turned violet. Thus, cell walls are … A. **cellulose** B. lignified C. cutinized D. mineralized E. suberinized	**Cellulose** is the structural component of the primary cell wall of green plants. Color reaction of cellulose: gives a violet color with chlor-zinc-iodine.

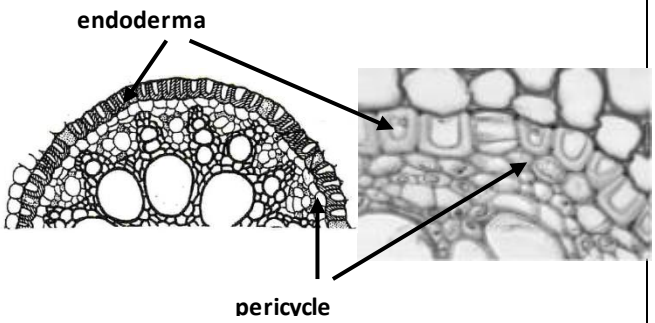
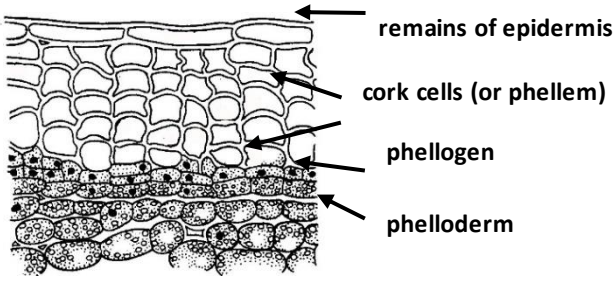
1.58. The cell walls of the inner epidermis of the pepper pericarp are penetrated with pits. In adjacent cells short cylindrical pit holes coincide as for their diameter and direction. These pits are … A. **straight** B. oblique C. chinked D. branched E. bordered	Simple **straight pits** have a short pits canal, which is situated transversely to the cell wall. 
1.59. Pericarp of nuts, stone of cherry, wood of stems are solid, because they accumulated ... in their cell wall. A. **lignin** B. silica C. chitin D. suberin E. calcium carbonate	**Lignin** is a substance of phenolic origin. It is occurence in the composition of the secondary cell wall of the mechanical and conductive tissues leads to their induration, lignification and dying of the protoplast.
1.60. Processing of the plant microslide with phloroglucinol with concentrated hydrochloric acid resulted in crimson-red colouring of cell walls, which indicates the presence of … A. **lignin** B. pectin C. cellulose D. hemicellulose E. suberin	Cell walls of plants are often impregnated with **lignin**. This process is called **lignification**. Cells become solid, strong, not elastic and stable to fungus and bacteria. Cells can be alive or dead. We know two quality reaction on the lignin such as: ✓ with aniline sulfate solution - yellow-green coloring of walls; ✓ with HCl and **phloroglucinol** - red coloring of walls;
1.61. Under the action of aniline sulphate reagent cell walls are coloured yellow, thus the walls are … A. **lignified** B. suberized C. cutinized D. sliming E. mineralized	
1.62. Suberization of the cell walls involves accumulation of … A. **suberin** B. lignin C. mucus D. calcium oxalate E. cutin	At the **suberization** cell walls are impregnated with ***suberin***. Suberin is a waxy substance found in a number of plants. Walls do not moisten with water, do not receive water and gas in and do not decompose. Cells are dead. Walls impregnated with suberin are colored with Sudan – III in pink and orange color.
1.63. The cell walls were coloured in orange as a result of interaction with Sudan III solution, which indicates the presence of … A. **suberin** B. cellulose C. pectin D. lignin E. hemicellulose	

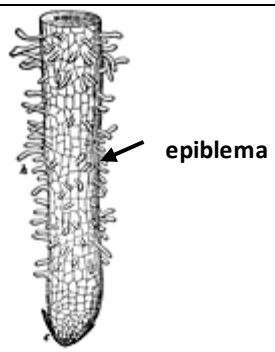
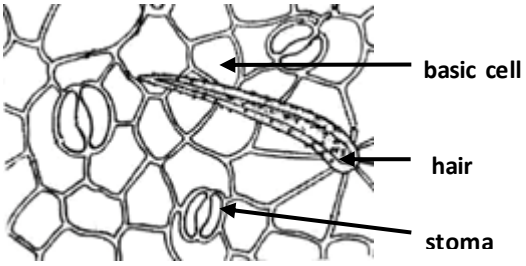
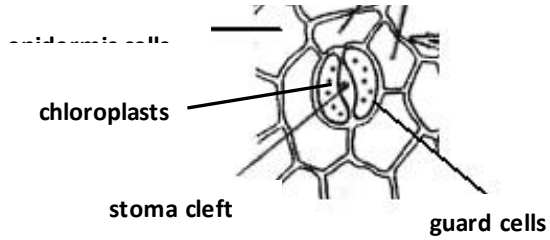
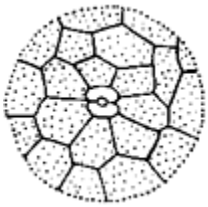
1.64. While we do microscopical analysis of the leaves we discovered thick layer of the lipoid substance. This is … A. **cutin** B suberin C. lignin D. mucus E. calcium carbonate	**Cutin** is cereous substances. Cutin it forms cuticle on epidermis of leaves, flowers, young stems and fruits. The function of the cutin is protect of the plant from the hight temperature, bacterius, microbians activity etc. 
1.65. Seeds of flax *(Linum usitatissimum)* are used as coating drug, due to the capability of cell walls to … A. **sliming** B. suberization C. suberization D. lignification E. mineralization	At the **sliming** intramolecular modification occurs in cell wall that results in formation of ***mucus***. You can see sliming of cell at algae, in semens of plants during of germination. Under the action of methylene blue cell walls containing mucus are dyed in blue colour.
1.66. As a result of the action of methylene blue solution on the cut of marshmallow root, secretory cells are colored blue. It indicates to the presence of ... A. **mucus** B. glycogen C. starch D. inulin E. lipids	**Mucus** is hydrated polysaccharides resulting from the degeneration of the mucous cells. Qualitative reaction is blue staining in alcoholic solution of methylene blue.
1.67. Destruction of intercellular substens and cell breakway in overripe fleshy fruits is a result of … A. **maceration** B. gummosis C. mineralizathion D. lignificathion E. sliming	Cells of the plants have strong cell walls. Their function is giving form to the cell, protection of the protoplast and turgor. Walls of the neighboring cells are joined with an intercellular substance – middle laminae. The phenomenon of the middle laminae destruction accompanying with cells distortion is called **maceration**.
1.68. A yellow pigment is present in the cell sap of the citrus pericarp. It gives the color to the fruit and is involved in redox reactions. It is ... A. **anthochlor** B. anthocyanin C. carotin D. xanthophyll E. fikobellin	**Antochlor** is a yellow flavonoid pigment, close to vitamin P, present in the cell sap of petals (toadflax, spring primrose), pericarp, in yellowed leaves. It participates in redox reactions.
1.69. …belong to excretory inclusions of plant cells. A. **essential oils** B. primary starch C. secondary starch D. transitional starch E. aleuronic grains	**Essential oil is** complex mixture of volatile aromatics substances. In the plant, essential oil is accumulated in secretory structures, such as glands, hairs, idioblasts, receptacles, channels. The reagent for detection of essential oil is Sudan III (drops of oil get orange color)
1.70. Essential oil of plant cell it`s … A. **mixture of volatile aromatic substances** B. crystallized proteins C. starch with inulin D. a mixture of resins and balsams E. mineral inclusions	

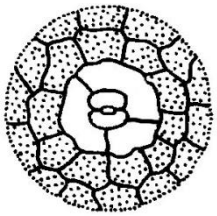
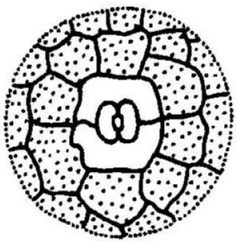
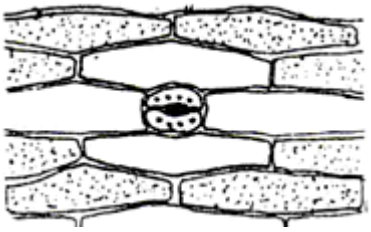
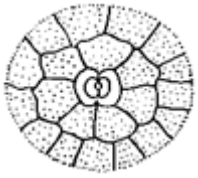
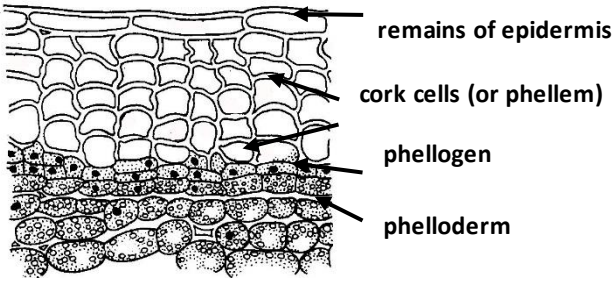
Content submodule 2

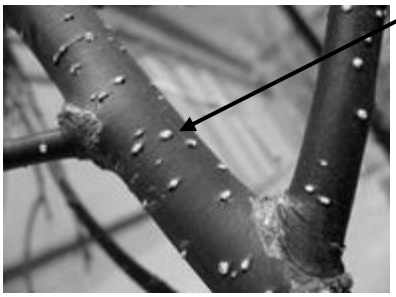
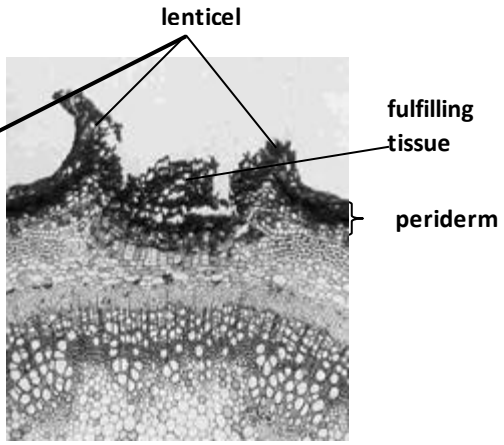
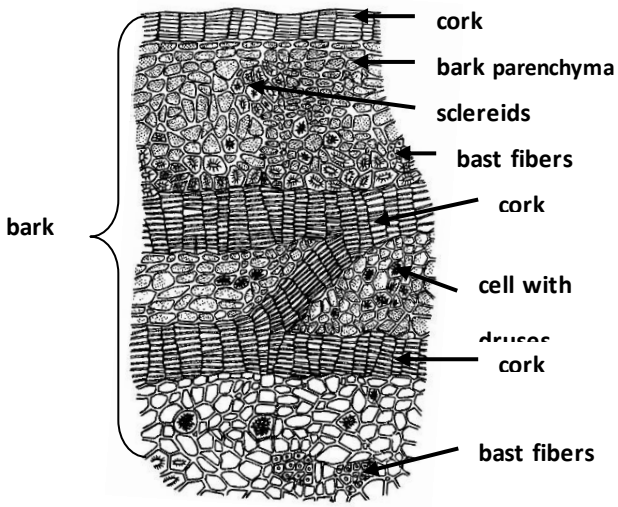
PLANT TISSUES

1.71. The tissue which was studied has a large nucleus, a thick cytoplasm without vacuoles; numerous mitochondias and ribosomes; a poor developed endoplasmic reticulum; no crystals. This is … A. **meristem** B. endosperm C. periderm D. epidermis E. epiblema  	**Meristematic tissues** are group of cells that have the ability to divide. These tissues in a plant consist of small, densely packed cells that can keep dividing to form new cells. Meristems give rise to permanent tissues and have the following characteristics. Sach as: meristem cells are parenchymatous, alive, tightly closed with thin walls. They have large nucleus, thick cytoplasmic fluid and numerous ribosomes, and with tiny vacuoles or no vacuoles at all. Chloroplasts and chromoplasts are absent; there are proplastids and leucoplasts.
1.72. Stem thickens due to the function of the … A. **lateral meristem** B. apical meristem C. traumatic meristem D. intercalary meristem E. endodermis	**Lateral meristems** coincidentally can be found growing laterally to the plant, cause it to grow laterally (i.e., larger in diameter). Lateral meristems are responsible for secondary thickening, which is required by perennial plants that grow year after year, and need the structural support to continue doing so.
1.73. While we do microscopical analysis of the axis organ between secondary phloem and secondary xylem we find 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. **cambium** B. procambium C. phellogen D. pericycle E. phelloderm	The **vascular cambium** is a secondary lateral meristem. The vascular cambium is the source of both the secondary xylem (inwards, towards the pith) and the secondary phloem (outwards), and is located between these tissues in the stems, roots and rhizomes. Vascular cambium is found in dicots and gymnosperms but not monocots, which usually lack secondary growth. 
1.74. Cambium is a … A. **secondary meristem** B. covering tissue C. primary meristem D. conductive tissue E. basic tissue	**Cambium (secondary lateral meristem)** is formed from procambium, pericycle or cells of basic tissues. Cambium is divids constantly and forms secondary phloem and xylem, thus it provides thickening of organs. **Cambium** replenishes phloem and xylem of open collateral and bicollateral bundles by new elements. It is typical for axial organs of dicots.
1.75. When determining the type and characteristics of vascular bundles of axial organs, it is necessary to consider mutual arrangement of the phloem and xylem, the presence of facings and ... A. **cambium** B. epiderm C. periderm D. pericycle E. phellogen	

1.76. The main role in the formation of lateral roots belongs to … A. **pericycle** B. procambium C. cambium D. apical meristem E. lateral meristerm	The **pericycle** is secondary lateral meristem. The pericycle is a cylinder of parenchyma cells that lies just inside the endoderma and is the outermost part of the stele of plants. In dicots, it also has the capacity to produce lateral roots. 
1.77. Lateral roots are formed endogenously and they develop as a result of the activity of the … A. **pericycle** B. procambium C. cambium D. apical meristem E. phellogen	
1.78. Microscopic examination of ground tissue of a small branch revealed cork and phelloderm. These are the derivates of: A. **phellogen** B. procambium C. cambium D. protoderm E. pericycle	
1.79. Microscopic examination of a stem of a perennial plant revealed integumentary tissue of secondary origin that was formed as a result of activity of … A. **phellogen** B. pericycle C. procambium D. cambium E. protoderm	
1.80. While microscopical analysis of the perennial plant stem we find covering tissue of the secondary origin, which is formed by the activity of … A. **phellogen** B. procambium C. cambium D. cortex parenchyma E. pericycle	**Phellogen** is secondary meristerm. Phellogen is situated between cork cells and phelloderm. Cells of the phellogen divide and form the cork cells and phelloderm. Those three tissues forming secondary covering tissues – **periderm** (see Fig. test 1.58, 1.61).
1.81. Lenticels are discovered in periderm of the perennial plant stem, they are formed by activity of … A. **phellogen** B. procambium C. cambium D. cortex parenchyma E. pericycle	**Lenticels** are adaptations in the periderm for gas and water exchange, which are formed from phellogen in the places, where the stomas are situated in the epidermis (see Fig. test 1.60).
1.82. Covering tissue has root hairs, have no stomas and cuticle. This is … A. **epiblema** B. epidermis C. periderm D. velamen E. exoderm	**Epiblema** (or *rhizoderma*) is a typical covering absorption tissue that covers an absorption zone of the root. It consists of alive thin-walled cells that provide absorption of water and mineral solutions

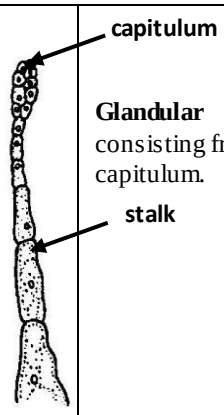
1.83. Microscopical examination of transverse section of root revealed investing tissue consisting of a thin-walled, closely joining cells with root fibrilla. This tissue is called: A. **epiblem** B. root cap (pileorhiza) C. epiderm D. endoderm E. periderm	
1.84. While we do microscopical analysis we 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	 **Epidermis** is comlex tissue consisting of *stomas (stomas apparatus)*, basic cells of epidermis and *trichomes* (or hairs). The epidermis is a single-layered group of cells that covers plants' leaves, flowers, roots and stems. The epidermis serves several functions, it protects against water loss, regulates gas exchange, secretes metabolic compounds.
1.85. In the leaf epidermis one can see complexes containing pairwise approximate semilunar cells with chloroplasts. These are … A. **stomas** B. hydatodes C. trichomes D. glandules E. lenticels` 	**Stomas (stomas apparatus)** are component of the epidermis. By their help gas exchange and transpiration are realized. Each stoma is bordered by two kidney-shaped cells that usually are smaller than most of the neighboring epidermal cells. These are called **guard cells** and unlike other cells of either epidermis, they contain chloroplasts and thick cell walls. Cells which are situated around guard cells, are called **subsidiary** cells. The stomatic cleft opens and closes because of turgor pressure changing, which is regulated of monosaccharides content formed in the process of photosynthesis.
1.86. Microscopy of epidermis of the dicot plant leaf has shown that cells around guard cells do not differ from the base cells. So, this type of stomata is … A. **anomocytic** B. diacytic C. paracytic D. tetracytic E. anisocytic	 **Anomocytic type** of stomata most propagation. Adverse cells uneducated. Guard cells surrounded by basal epidermal cells.

1.87. Leaves of the plants Mustard *(Brassicaceae)* Family are covered by epidermis, which has stoma apparatus with three subsidiary cells of different size. These types of stoma apparatus is called … A. **anisocytic** B. diacytic C. paracytic D. anomocytic E. tetracytic	 **Anisocytic type** is a type where three cells are situated around stomata, and one of them is smaller or large than others (e.g. families *Brassicaceae* , *Polygonaceae*, etc.)
1.88. While microscopical study of the epidermis of the Lamiaceae (Mint) Family leaf it is ascertained that both subsidiary cells of the stomas are situated transversely to stoma slit. Stoma apparatus is … A. **diacytic** B. anomocytic C. anisocytic D. tetracytic E. paracytic	 **Diacytic type** is a type when two subsidiary cells are situated around stomata and their adjacent side is perpendicular to stomatic cleft (e.g. families *Lamiaceae, Myrtaceae*).
1.89. Microscopy of a leaf epidermis of **Convallaria majalis** showed that the stomata had four accessory cells. Two of them were lateral, and two other were polar. What type of stomatal mechanism is it? A. **tetracytic** B. diacytic C. anomocytic D. paracytic E. anisocytic	**Tetracytic type** is a type where the stoma with four subsidiary cells, two of them are lateral and another two are polar (e.g. families of the Monocots, rarely – Dicots). 
1.90. Stomas of leaf epidermis of **Vinca minor** have two subsidiary cells; their longitudinal axes are parallel to the somatic cleft. So, stoma apparatus is ... A. **paracytic** B. diacytic C. anomocytic D. tetracytic E. anisocytic	 Two subsidiary cells, which join parallel to the stomata cleft is typical for **paracytic type** stomata apparatus (e.g. Fagaceae, Rosaceae, Myrtaceae,Apocynaceae family etc.).
1.91. While we do 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. **cork** cells (or phellema) B. epiblema C. epidermis D. collenchyme E. chlorenchyma	
1.92. While we do microscopical study of the stem we found out a covering tissue which consists of cork, phellogen and phelloderm. This tissue complex forms … A. **periderm** B. epidermis C. xylem D. phloem E. collenchyma	**Periderm** is complex tissue consisting from cork (or phellem), phellogen (or cork cambium) and phelloderm. It is the secondary integumentary tissue which is formed in the perennial dicots and gymnospermous stems by the end of the first year of living in the result of phellogen is activity. It has protective function.
1.93. Phellogen is formed either from pericycle or from the basic tissue which is obtaining the meristem activity. Name the type of tissue which is formed from fellogen. A. **covering tissue**	A **meristem** is a tissue in most plants consisting of undifferentiated cells (meristemate cells), foun in zones of the plant where growth can take place.

B. meristem C. excretory tissue D. strengthening (mechanical) tissue E. conductive tissue	
1.94. When studied stem covered with periderm researcher we came to the conclusion that gaseous exchange takes place through: A. **lenticels** B. hydatodes C. stomata D. pores E. throughput cells 	 **Lenticel** formation begins during the development of the first periderm. In the stem, they usually appear below a stoma or group of stomata. Lenticels are found as raised circular, oval, or elongated areas on stems. As stems mature lenticel development continues in the newly forming periderm found at the bottom of cracks in the bark. The function of the lenticels is gas and water exchange.
1.95. While we do microscopical analysis we find complex tissue, which consists of periderm aggregate. This is … A. **bark** B. epidermis C. epiblema D. exoderm E. velamen	 **Bark (or cortex)** is formed on stems of trees on the 8-30th years of living as a result of repeatedly location and activity of phellogen. It consists of sums of periderms.

1.96. While we do microscopical analysis of the leaves we discovered structures, which consist of long stalk and small secretory multicellular head. They are …

A. **glandular hairs**
B. covering hairs
C. stringing hairs
D. hydatodes
E. thorns

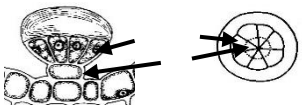


Glandular hairs are exogenous secretory structures consisting from long multicellular stalk and small secretory capitulum.

1.97. Plants of the *Lamiaceae* Family have rounded exogenous secretory structures with a short unicellular stalk and 8–12 radially situated secretory cells. These are …

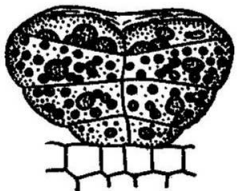
A. **essential oil glandules**
B. nectarines
C. osmophores
D. hydatodes (or water stomas)
E. glandular hairs

Glandules consist of stalk and secretory capitulum which may include different number of cells. Glandules are alive multicellular trichomes with short stalk and large head where under its cuticle essential oils, gums, mucus and other secrets are accumulated.
The secretory cells of the head are situated raddially This structure is typical for plants of Mint (*Lamiacee*) Family.



1.98. By microscopical analysis of the plant (in epidermis) we discover glandules, where cells are situated by two cells in 3 – 6 layers, so the plant belongs to the Family...

A. **Asteraceae (Sunflower)**
B. Scrophulariaceae (Figwort)
C. Solanaceae (Potato)
D. Apiaceae (Carrot)
E. Lamiaceae (Mint)



view from the side

1.99. Essential oil glandules that consist of 8 secretory cells placed in 2 lines and 4 tiers are typical for most plants of the following family:

A. **Asteraceae (Sunflower)**
B. Lamiaceae (Mint)
C. Solanaceae (Nightshade)
D. Scrophulariaceae (Figwort)
E. Apiaceae (Carrot)

The secretory cells of the head are situated by two (in pairs). This structure is typical for plants of Aster (*Asteraceae*) Family.

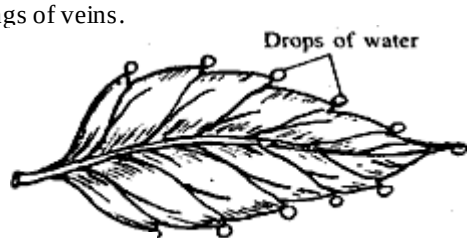
1.100. Excretory structures, which excrete water with mineral substances in liquid state, are situated on the serrations of the leaf. Water excretes through the slits between two open guard cells. These are …

A. **hydathodes**
B. osmophores
C. emergence
D. glandular hair
E. glandule

1.101. Microscopic examination of leaf serration revealed secretory structures secreting some liquid. What are these structures called?

A. hydatodes
B. nectaries
C. stomata
D. glandules
E. osmophores

Hydathodes (or water stomata) are special stomata found at the margin and tips of the leaves where the main veins ends. Hydatodes excrete water with mineral substances. The process of water excretion with hydatodes is called **guttation**. Each hydathode has a pore which always remain open. The pore leads to a small cavity, the stomatal chamber followed by a group of loosely arranged cells called epithem. These cells are in close contact with xylem endings of veins.

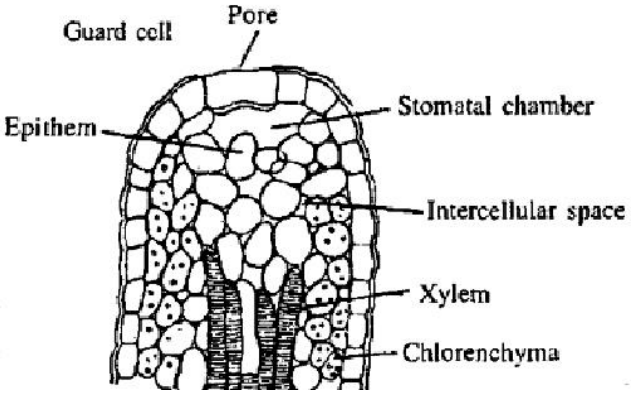


leaf with hydathodes

1.102. Under the microscope on the denticles of the leaf we discover secretory structures that excrete drops of liquid. These structures are …
A. **hydatodes**
B. nectarine
C. stomas
D. glandules
E. osmophores

1.103. While microscopical study of the leaf on the denticles there are determined water stomas which are the appliance for excretion of liquid drops, i.e. realizing the process of…
A. **guttation**
B. gas exchange
C. endogenous secretory
D. transpiration
E. photosynthesis

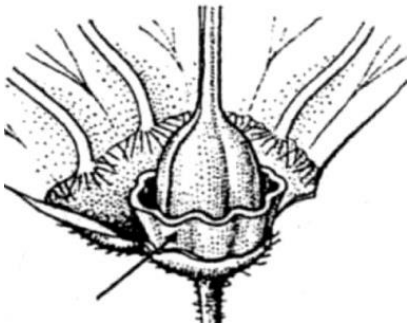
1.104. Microscopical examination of leaf revealed water stomata on its serration. These stomata are for exudation of liquid-drop moisture. This process is called:
A. **guttation**
B. photosynthesis
C. transpiration
D. internal secretion
E. gas exchange



1.105. In the flower we determine secretory structures, which excrete sugary solutions that attract pollinators. This is …
A. **nectaries**
B. osmophores
C. stinging hair
D. sticky hair
E. hydatodes

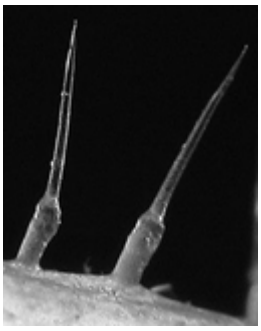
1.106. External secretory structures include …
A. **nectaries**
B. idioblast
C. lacticifer
D. resinous canals
E. conceptacle

1.107. Nectaries usually contain …
A. **solutions of sugars**
B. essential oils
C. food enzymes
D. mucus
E. latex

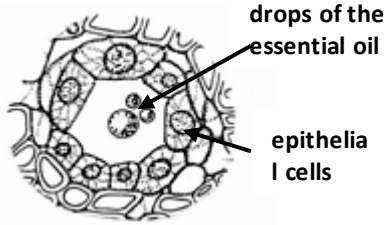
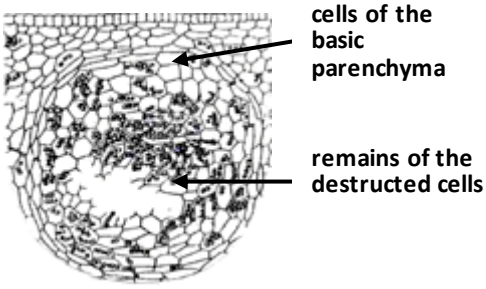


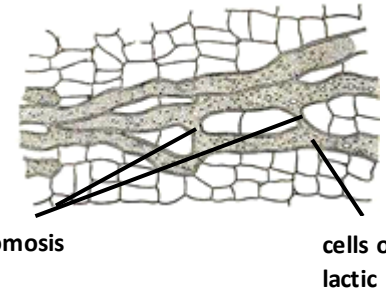
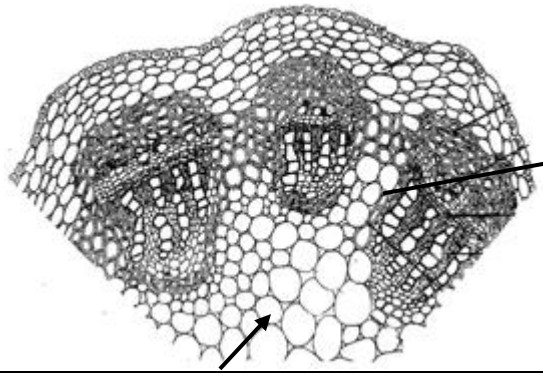
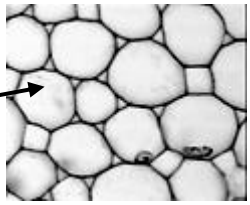
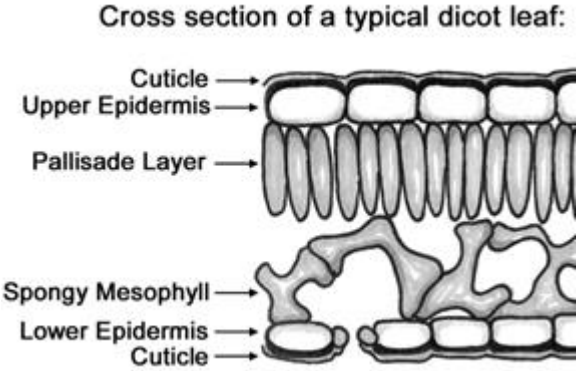
Nectaries *(nectar glandules)* are multicellular formations that are situated on the flowers and vegetative parts of plants. Form of nectar glandules is different and species-specific. Sometimes petals or undeveloped stamen-staminodes turn into nectar glandules. Secretory function can be realized not only by epidermal layer but also subepidermal layers.

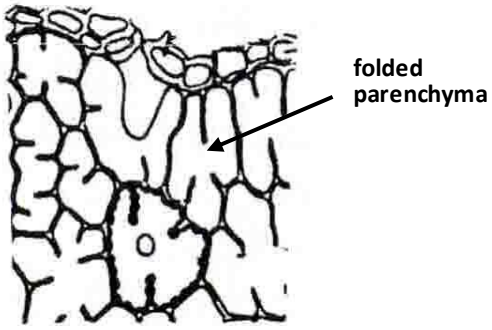
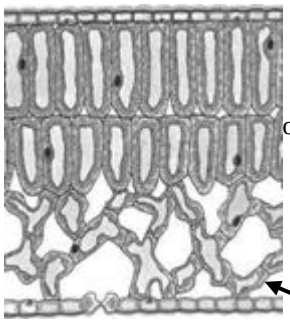
1.108. While microscopical analysis of the *Urtica dioica* leaf we find large growths, which consist of multicellular stay, ampulla-shaped alive cell with small mineralized head. Cell sap contains substances, which cause irritation. This structure is …
A. **stinging hair**
B. covering hair
C. peltate scale
D. seta
E. glandular hair



Stinging hair typical for *Urtica dioica (Urticaceae)*.

1.109. In epidermis of the madder dye leaf there have been identified multicellular spiny outgrowths; epidermal and subepidermal cells take part in their formation. These outgrowths are ... A. **emergences** B. simple trichomes (or hairs) C. glandular hair D. glandules E. stinging hairs	**Emergences** are formed by participation of epidermal and subepidermal cells. They can form multicellular stays, rosettes and other multicellular structures of trichomes (*nettle, hops, marena*).
1.110. In the wood of the *Pinus sylvestris* essential oils are accumulated in resin channels, which are covered inside with a layer of secretory cells. Those structures are called … A. **schizogenous conceptacles** B. lysigenous conceptacles C. articulate lacticifers D. non-articulate lacticifers E. cells-idioblasts	**Schizogenous conceptacles** are endogenous excretory structures (e.g. pine tree). They can have view of the cavities – intercellular or the tubular structures that are lined by secretory cells. Secretory cells release different substances (balsam, essential oil, gum and other) into cavity.  **Schizogenous conceptacle of the pine tree**
1.111. It is known that the leaves of *Eucalyptus globulus* have cavities with well-defined internal boundaries and filled with essential oils. They are called: **A. schizogenous cavities** B. non-articulated lacticifers C. schizolysigenous cavities D. articulated lacticifers E. lysigenous cavities	
1.112. In folded parenchyma of the pine leaf we discover hollow structures that are lined with secretory cells and contain thick gum. These are … A. **schizogenous conceptacles** B. nectarines C. osmophores D. hydatodes (or water stomas) E. lacticifers	
1.113. On the cross section of the *Citrus* exocarp we discovered large secretory structures without exact outline. This is … A. **lysigenous conceptacle** B. schizogenous conceptacle C. cells-idioblast D. articulate lacticifer E. non-articulate lacticifer	**Lysigenous conceptacles** are endogenous excretory structures (e.g. citrus). They are formed at the destroying of secretory cells that is why the cavity of conceptacle doesn't have exact outline.  **lysigenous conceptacle of the citrus**
1.114. It is known that rhizome and roots of elegampane inula *(Inula helenium)* have cavities without distincts inner boundaries filled with essential oils. They are called: A. **lysigenous receptacles** B. segmented lacticifers C. schizogenous receptacles D. nonsegmented lecticifers E. resin ducts	
1.115. While we do microscopical study of the poppy pericarp it is determined, that there are tube structures with white latex. They are … A. **lacticifers** B. secretory glands C. lysigenicous conceptacle D. secretory cells E. schizogenous conceptacle	The **lacticifers** (see Fig. test 1.74) are endogenous secretory structures. **Lacticifers** are prosenchymatous cells or multicellular tubular formations that contain latex of complicated composition. **Latex** is a frequently milky plant exudate, often containing rubber, found in specialized cells called laticifers.

1.116. On the longitudinal section of the *dandelion* root in cortex we find secretory structures with thick contents in the form of winding tubules, which are formed with series of cells. Such structures are called … A. **articulate lacticifer with anastomosis** B. articulate lacticifer without anastomosis C. non-articulate non-branched lacticifer D. non-articulate branched lacticifer E. schizogenous cannals	**Articulate lacticifers with anastomosis** are tubers who joined with transverse septum(anastamosis).  	
1.117. Some plants accumulate latex in … A. **lacticifers** B. cells-idioblasts C. glandules D. hydatodes E. conceptacles	**Lacticifer**s are prosenchymatous alive cells or multicellular tubular formations that contain latex of complicated composition.	
1.118. Cells of the stem pith are parenchymal and alive. They have large intercellular spaces and thin porous walls. This tissue is … A. **basic** B. conductive C. meristematic D. mechanical E. covering  pith	**Basic tissue (or parenchyma)** is called fulfilling because it forms a base of organs and fill cavity between other tissues. It is alive parenchymal tissue that can preserve meristematic activity. According to the structure of cells, functions and location in organs, parenchyma is divided into assimilative, storage, absorptive, aerenchyma, and water bearing. The pith of stem is filling of parenchymatous cells who is situated spongiose. 	
1.119. In a sample studied under a microscope the multilayer palisade (columnar) parenchyma can be clearly seen. Such structure is typical for: **A. leaf** B. root C. dicotyledon stem D. rhizomes of ferns E. adventitious roots	 	
1.120. Under the epidermis of a leaf we find green tissue which consists of alive, oblong and tightly closed cells. These cells are orthogonally oriented to the leaf surface. This is a parenchyma of … A. **columnar (or palisade)** B. spongy C. folded D. storage E. auriferous		
1.121. While microscopical study of the leaf we discover that some layers of the chlorophyll-bearing		

cells are situated under epidermis. These cells have elongated form and are situated obliquely to the surface of a leaf with large amount of chloroplasts. So, this parenchyma is called … A. **palisade** B. folded C. storage D. water-bearing E. spongy	
1.122. The cells of leaf mesophyll are elongated, densely close with thin, straight walls and large quantity of chloroplasts, so, chlorenchyma is … A. **palisade** B. spongy C. folded D. storage E. aerenchyma	
1.123. While microscopical study of the pine leaf we find that mesophyll consists of cells, which have many chloroplasts and sinuous cell walls. So, mesophyll is formed by … parenchyma. A. **folded (plicate)** B. palisade C. storage D. water-bearing E. spongy	**Folded parenchyma** is found in the leaves of some coniferous trees (pine-tree). Its cells have internal folds of walls along which chloroplasts are situated, what increase photosynthesis surface of leaf. 
1.124. While microscopical study of the needle-shaped leaf we consider alive tissue with inner ansate growths of cell wall, along which there are situated chloroplasts, so this parenchyma is … A. **folded** B. spongy C. palisade D. folded and palisade E. palisade and spongy	
1.125. Basic tissue of green leaf consists of living thin-walled, parenchymatous cells and large intercellular spaces. This parenchyma is ... A. **spongy (or lacunose)** B. palisade (or columnar) C. folded D. storage E. venting	 **Spongy (or lacunose) parenchyma** has lax location of cells of different size with small number of chloroplasts. Cells are situated friably, because there are big intercellular spaces. spongy (or lacunose) parenchyma

1.126. Basic parenchyma is developed in seeds, pericarp, cortex, stem core and underground organs. It contains starch and aleuronic grains, drops of fatty oil. This parenchyma is …

A. **storage**
B. water-storage (or hydrophoric)
C. aerenchyma (or air-containing)
D. assimilative palisade (or columnar)
E. assimilative spongy (or lacunose)

1.127. Underground location of rhizomes determines the fact that the most developed tissue is …

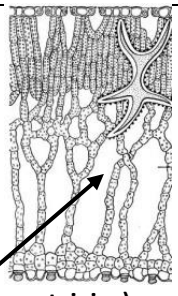
A. **storage parenchyma**
B. chlorenchyma
C. aerenchyma
D. xylem
E. collenchyma

Storage parenchyma contains grains of starch, aleuronic or drops of fatty oil. It is situated in the cortex, wood and pith of vegetative organs, in seeds (endosperm, perisperm, cotyledons), in the underground organs – rhizomes, tubers, food-storage roots, edible roots, bulbs, etc.

1.128. Basic parenchyma of the hydrophytes and hygrophytes leaves with a developt system of intercellular spaces that promotes ventilation and flotage has been studied. This parenchyma is…

A. **aerenchyma (or air-containing)**
B. water-storage (or hydrophoric)
C. assimilative spongy (or lacunose)
D. storage
E. assimilative folded

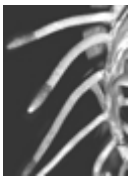
Aerenchyma or air-containing parenchyma is a venting tissue with a large air cavity. It is especially well-developed in hygrophytes and hydrophytes, in which it promotes flotage of leaves.



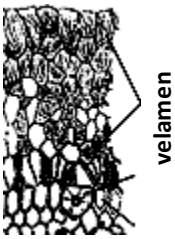
Aerenchyma(or air-containing)

1.129. Air roots of *orchids* are covered with a multi-layer protecting, absorbing and photosynthesizing tissue of protodermal origin. It is ..

A. **velamen**
B. epiblema
C. periderm
D. cortex
E. epiderm



Velamen is a multilayer covering absorption tissue, it is capable to photosynthesis. It is formed from protoderma air roots of epiphytes.



1.130. 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 cells of strengthening tissues from the list below contain a living protoplast?

A. **collenchyma**
B. sclereids
C. libriform
D. perivascular fibers
E. bast fibers

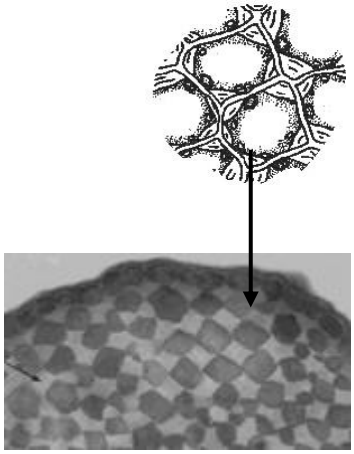
1.131. Anatomical and histochemical analyses of the petiole show that under the epidermis and above the conductive bundle there are alive parenchymal multangular cells with cellulose walls, thickened in cell angles. This is typical for …

A. **angular collenchyma**
B. spongy parenchyma
C. lamellar collenchyma
D. lacunar collenchyma
E. bust fiber

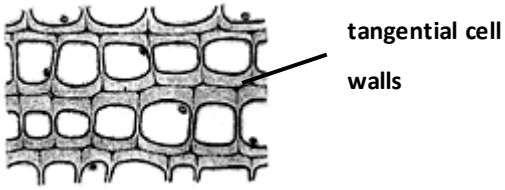
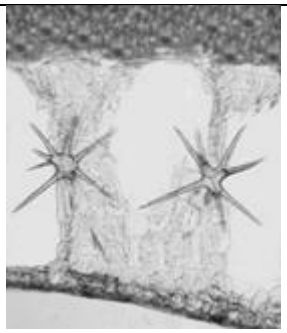
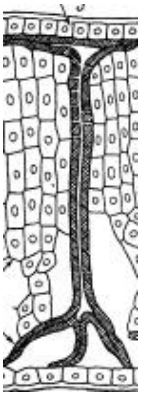
1.132. Some layers of alive parenchymatous cells are discovered on the cross section. Cells contain chloroplasts; cell walls are thickened on the angles. This is …

A. **angular collenchyma**
B. lamellar collenchyma

The **collenchyma** is alive mechanical tissue with cellulose irregularly thickened cell's wall. It typical for stem and veins of the leaf of the dicots. Collenchyma is situated at the periphery of the stem as entire, interrupted cylinders or separate bands. According to the character of walls thickening and density of the cell location there are *angular, lamellar and lacunar* collenchyma. The cells of the angular collenchyma are tightly joined, walls are thickened by angles.



angular collenchyma

C. lacunar collenchyma D. storage parenchyma E. aerenchyma	
1.133. Anatomico-histochemical analysis of a petiole revealed living parenchyma cells with cellulose, angular thickened membranes under the epiderm and above the fascicle. This is typical for: A. **angular collenchyma** B. lamellar collenchyme C. spongy parenchyma D. lacunar collenchyme E. bast fibers	
1.134. Anatomical and histochemical analyses of petiole shows that under epidermis there are alive parenchymal cells with cellulose and thickened tangential cell walls. This is … A. **lamellar collenchyma** B. angular collenchyma C. lacunar collenchyma D. spongy parenchyma E. palisade parenchyma	**Lamellar collenchyma** has thickenings on their tangential walls, which are parallel with the surface. 
1.135. While we do microscopical studying of the leaf we find stellar sclereids. These are … A. **astrosclereids** B. osteosclereids C. trichosclereids D. macrosclereids E. brachisclereids	 **cross-section through a living *Nymphaea* leaf.** **Astrosclereid** (asterosclereid, star sclereid) A relatively short sclerenchyma cell (sclereid). Astrosclereids are usually present singly or in small groups and are often found in the mesophyll of leaves, where they act as a strengthening agent.
1.136. Microscopy of the fruit pulp of quince has found sclereids of isodiametric form. They are … A **brachysclereids** B. astrosclereids C. thread-like sclereids D. osteosclereide E. macrosclereids **1.137**. In the pulp of leaves (*tea, begonia, ivy*) there are sclereids that are dumbbell-shaped or have a form of tubular bones. They are ... A. **osteosclereides** B. macrosclereids C. thread-like sclereids D. astrosclereids E. brachysclereids	**Sclereids** are dead supporting cells of various shapes with uniformly thickened, woody, lamellar walls. The walls are penetrated with chinked and branched pores. **Brahisklereids** have isodiametric form and are found in seed coats, fruit pulp and leaves, as well as axial parenchyma organs. **Osteosklereids** are baculiform-shaped with thickened ends. 

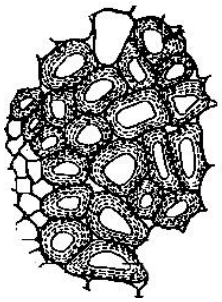
1.138. While microscopical analysis of the longitudinal section of the flax *(Linum)* stem on the periphery we find groups tightly closed prosenchymatous cells with pointed ends and strongly thickened lamellar cellulose cell walls, which are penetrated with oblique pores. So, this is …

A. **bast fibers**
B. wood fibers
C. cortex fibers
D. tracheids
E. vessels

1.139. In composition of the stem phloem there are groups of the densely close prosenchymatous cells with pointed ends, evenly thickened, lamellar, partly lignified cell walls. These are …

A. **phloem fibers**
B. xylem fibers
C. tracheids
D. sclereids
E. collenchyma

Bast fibers (or phloem) are very long cells with thickened, slaty, cellulose, partly or completely lignificated cells walls that are penetrated by oblique pores. Foliation of walls depends on interchange of layers with different content of cellulose, hemicelluloses and pectin substances, and striation depends on cancellated location of fibrils. The length of phloem fibers can varies from 4 to 350 mm. Form of the phloem fibers point and their joining are the specific characteristic of a plant (flax has mucronat phloem fibers, hemp has clavate or branchy, kenaf has dentate ones etc.)



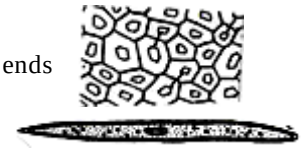
cross section

longitudinal section

1.140. Sclerenchyma consists of thickened cell walls, which are impregnated with lignin. These fibers are …

A. **wood**
B. bast
C. cortex
D. perivascular
E. sheath

Wood fibers are a type of sclerenchyma. The cells are prosenchymatous with pointed ends and thickened lignified walls.



1.141. Having been studied, conifer wood is determined to be composed of cells with pointed ends and lignified ring-porous cell wall. Therefore, this tissue of conifers is represented only by:

A. tracheids
B. vessels
C. sieve tubes
D. companion cells
E. bast fibers

1.142. Ascending transport of water and soluted minerals is provided by …

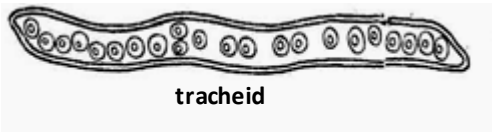
A. **vessels and tracheids**
B. sieve tubes
C. wood fibers (libriform)
D. bast fibers
E. sclerenchyma

Conductive tissues provide locomotion through the plant of two streams of substances: ***ascending current*** that brings water and solutions of mineral substances from the root to overground parts of plants and ***descending current*** that brings products of photosynthesis from leaves to all parts of plants.

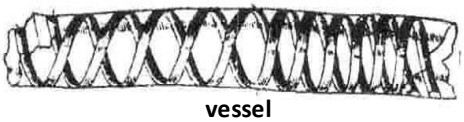
Vessels and tracheids form an efficient system for transporting water and mineral salts (including necessary minerals) from the root to the leaves and other parts of the plant.

Vessels are formed from cells of procambium or cambium, which stretch, their transverse walls perforate or solve, protoplast die off, cell walls become thicker and lignificated.

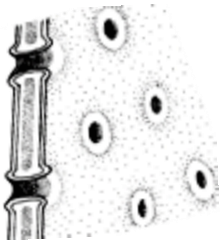
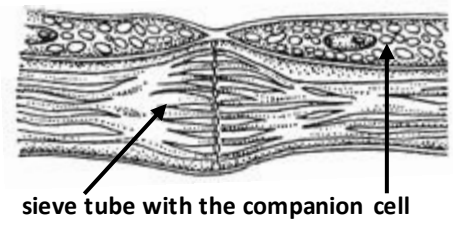
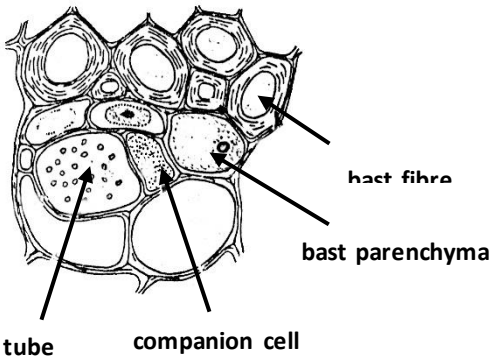
Tracheids are elongated prosenchymatous cells with sharp top and border pits in the xylem of vascular plants.



tracheid



vessel

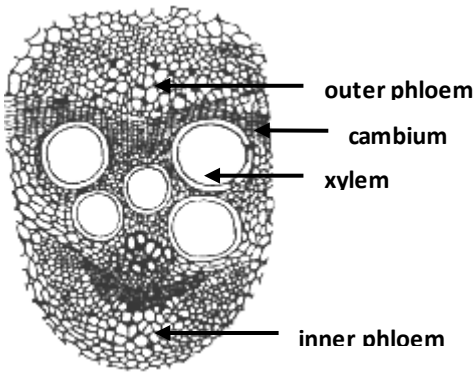
1.143. By means of microscopic analyses it has been observed prosenchymatous cells with bordered pits,which are typical for … tisue A. **conductive** B. mechanical C. storage D. covering E. meristematic 	**Tracheids** are prosenchymatous **conducting** tissues of wood (xylem) that ensure movement of water and mineral substances. They are characterized by presence of bordered pits.
1.144. It is determined that transport of photosynthesis products is provided by the … A. **sieve tubers** B. vessels C. tracheids D. parenchyma E. bast fiber	Ordinary companions cells, which have smooth walls and few or no plasmodesmata connections to cells other them sieve tube. Companion cells and sieve elements are of meristimatic origin. 
1.145. Descending stream of organic substances from leaves to all plant organs is provided by … A. **sieve tubers** B. vessels C. tracheids D. bast fibers E. wood fibers	
1.146. While microscopical analysis of the stem we find complex tissues, which include such histological elements as: sieve tubes with companion cells, bast fibers, bast parenchyma. It's typical for … A. **phloem** B. xylem C. epidermis D. cortex E. periderm	**Phloem** is the vascular tissue**.** Its principal function is the conducting of assimilates and food. It is composed of the sieve elements, of which two types can be distinguished, sieve cells and sieve-tube members. **Companion cells** produce enzymes that proceed into sieve tubes and stimulate their work. **Bast (or phloem)** can be the primary or secondary origin. It consists of conductive tissues – sieve cells (or sieve tubes) and companion cells, the mechanical tissue - bast fibers and the storage tissue – bast parenchyma. 
1.147. The main conductive components of leaf vein tissues are ... A. **xylem and phloem** B. collenchyma and sclerenchyma C. epidermis and periderm D. aerenchyma and chlorenchyma E. phloem and collenchyma	**Xylem and phloem** are conductive tissues of leaf veins, which provide ascending and descending currents of substances. Often they are surrounded by sclerenchymal or parenchymal armature.

1.148. On the photomicrograph of a herbaceous plant stem the bicollateral vascular bundles are clearly visible. The microspecimen represents the stem of the following plant:

A. pumpkin
B. rye
C. flax
D. corn
E. solomon's seal

1.149. On the cross section of the pumpkin (*Cucurbita*) stem it can be well seen that open conductive have two parts of phloem: inner and outer. These bundles are

A. **bicollateral**
B. collateral
C. radial
D. concentric with the phloem in the center
E. concentric with the xylem in the center

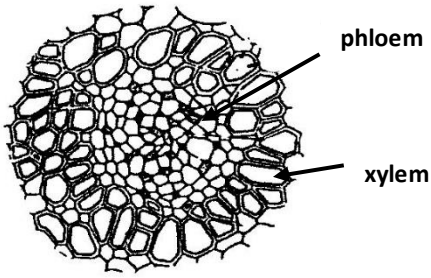


In a **bicollateral bundle**, the phloem is both outside and inside the xylem, as in the cucumber Family (*Cucurbitaceae*) and the potato family (*Solanaceae*).

1.150. Conductive bundles with the phloem in the centre and xylem around it are typical for rhizomes of the lily-of-the-valley *(Convalaria majalis)*. There are …

A. **concentric centerphloem bundles**
B. concentric centerxylem bundles
C. radial bundles
D. bicollateral bundles
E. collateral bundles

`



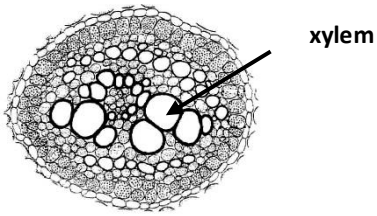
1.151. While we do microscopic analysis of the rhizome we found centroxylem conductive bundles, so the rhizome belongs to …

A. **Dryopteris filix-mas**
B. Potentilla erecta
C. Convallaria majalis
D. Agropiron repens
E. Acorus calamus

1.152. While we do microscopic analysis of the rhizome we found centroxylem conductive bundles, so the plant belongs to …

A. **fern**
B. algae
C. dicot
D. monocot
E. gymnospermae

Centroxylem bundles are typical to **fern** (e.g. Dryopteris filix-mas).

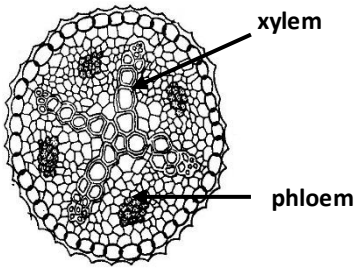


1.153. Conductive bundle is discovered on the cross section of the axis organ; its phloem and xylem are situated separately, which take turns radially. So, this type of the bundle is …

A. **radial**
B. centroxylem
C. centrophloem
D. collateral
E. bicollateral

1.154. What type of conductive bundle is typical for primary anatomic structure of the root?

A. **radial**
B. concentric
C. collateral closed
D. bicollateral
E. collateral open



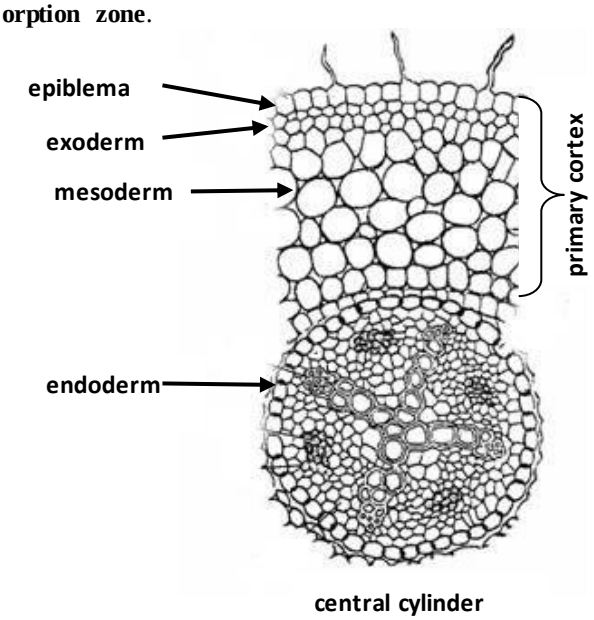
Radial bundles are typical to roots.
In radial bundle phloem occur between xylem rices.

Content submodule 3.
ANATOMY OF THE VEGETATIVE ORGANS

1.155. It microscopic structure of the root, in the absorption zone, we distinguish: …
A. **primary cortex, central cylinder**
B. secondary cortex, phloem
C. wood, core
D. primary cortex, periderm
E. secondary cortex, mesophyll

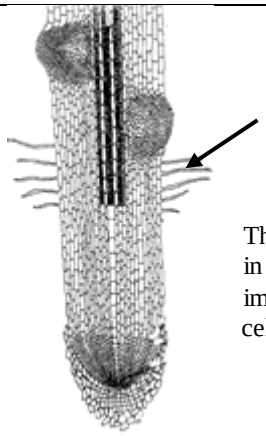
1.156. In the root, completion of meristem cell differentiation and formation of primary anatomical structure occur in the zone of...
A. **absorption**
B. cell division
C. conduct
D. growth
E. root cap

Primary anatomical structure of the root is formed in its **absorption zone**.



1.157. 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. **absorption**
B. cell division
C. growth and elongation
D. anchoring and conducting
E. root cap

1.158. On cross-section of a 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

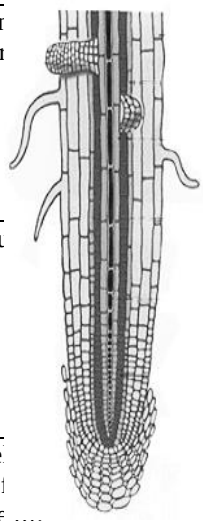


The **absorption** mainly takes place in root hair region. This region lies immediately above the region of cell elongation.

1.159. In the root structure a regio
tissue with root hairs. This is a regio
A. **absorption**
B. cell division
C. growth and elongation
D. anchoring and conducting
E. root cap

1.160 The root of a dicot plant acq
anatomic structure in the region …
A. **anchoring and conducting**
B. root hairs
C. growth and elongation
D. cell division
E. root cap

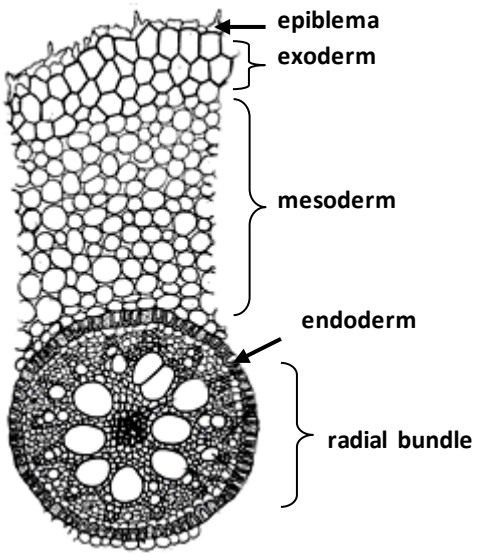
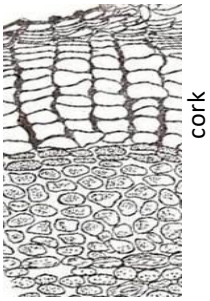
1.161. On the root section of He
secondary fascicular structure was
that the section was made in the zone
A. **fixation and conduction**
B. growth and elongation
C. cell division



region of anchoring and conducting

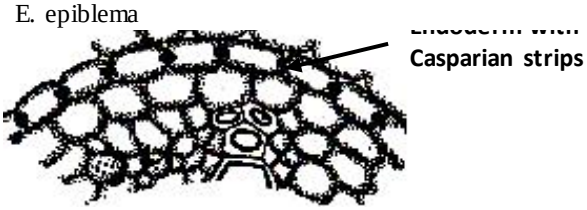
region of

The **anchoring and conducting** zone of a root is situated above the absorption zone. It provides two currents of substances (water with minerals and organic substances)

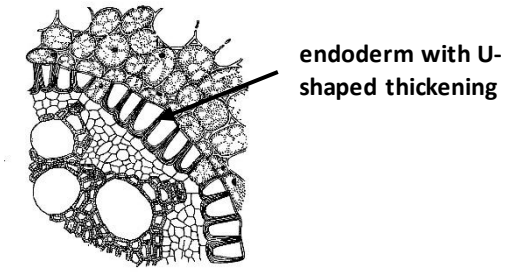
D. absorption E. root cap (pileorhiza)	moving and also strengthening of the plant due to lateral roots creation.
1.162. By microscopical study of the root cross-section we observe cover tissue, which consists of thin-walled, tightly closed cells with root hairs. This is … A. **epiblema** B. root cap C. periderm D. endoderm E. epiderm	The external protective covering layer of roots is called **epiblema** (the term epidermis is generally not applied to roots). It is uniseriate and has root hairs. Epiblema fulfills absorbing and protective functions.
1.163. During microscopical study of the primary cortex of the root we determine that under the epiblema are 3-4 lines of big, multangular, and tightly closed cells with partly suberized cell walls. This tissue is … A. **exoderm** B. endoderm C. mesoderm D. epiblema E. phellogen	Under **epiblema** there is a wide primary cortex, which consists of **exoderm**, **mesoderm** and **endoderm**. **Exoderm** has 2–5 layers. Its cells are big, multi-angled, with a corked cell wall, closely joint. It has a protective and conducting function. **Mesoderm** is multi-lined and compounds the main part of the primary cortex. Its cells are alive, big, roundish or multi-lined, with thin cell walls. Its cells situated friable are filled up with grains of starch. It has a protective and conducting function.
1.164. In the root of the primary structure storage substances are reserved in … A. **mesoderm** B. pericycle C. endoderm D. central cylinder E. exoderm	
1.165. During 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 grains. This is … A. **mesoderm** B. endodermis C. exoderm D. collenchyma E. phloem	
1.166. Microscopic examination of a root cortex in the absorbing zone revealed that it consists mainly of multilayer living loose parenchyma with starch granules. This is: A. **mesoderm** B. collenchyme C. endoderm D. exoderm E. phellogen	
1.167. Rhizomes' underground location determines that the most developed tissue is ... A. **storage parenchyma** B. chlorenchyma C. aerenchyma D. xylem E. collenchymas	**Rhizomes** are underground metamorphosis of the shoot of perennial plants. Nutritional and biologically active substances are accumulated in the **storage parenchyma** of cortex and axial cylinder. **Periderma** is secondary covering tissue, which typical for underground and overground stems of Dicots. 
1.168. Rhizomes of dicot plants are covered with ... A. **periderm** B. epiblema C. exoderm D. endoderm E. epidermis	
1.169. In the microscopical analysis of the root cross section of a dicot plant made in the absorption region we found a line of cells with lenticular suberizing thickenings – Casparian strips. These are cells of the…	The **endoderm**, present in all roots, is believed to function in regulating the flow of water into the vascular cylinder from the cortex. The cell sides of the endoderm have lens like thickening – Casparian strips (for Dicots) or they have

A. **endoderm**
B. exoderm
C. mesoderm
D. pericycle
E. central cylinder

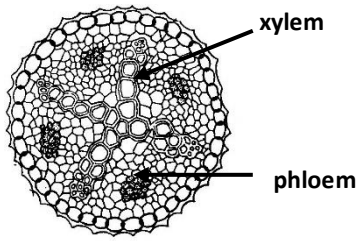
1.170. During microscopical study of the rhizome cross-section of the monocot plant we determine that cells of the inner layer of primary cortex have U-shaped thickenings of the cell walls. This tissue is …
A. **endoderm**
B. phellogen
C. exoderm
D. pericycle
E. epiblema



the U-shaped thickening of the cell wall, become corked and die off (for Monocots). Among these dead cells there are an alive passage cells that let water and mineral substances solutions come to vessels.

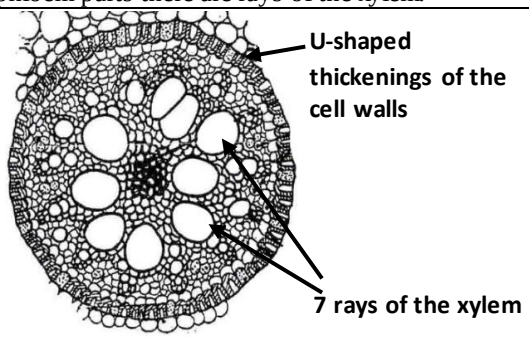


1.171. What type of conductive bundle is typical for primary anatomic structure of the root?
A. **radial**
B. concentric
C. collateral closed
D. bicollateral
E. collateral open



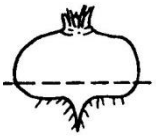
Radial bundles are typical to root.
The phloem parts there are rays of the xylem.

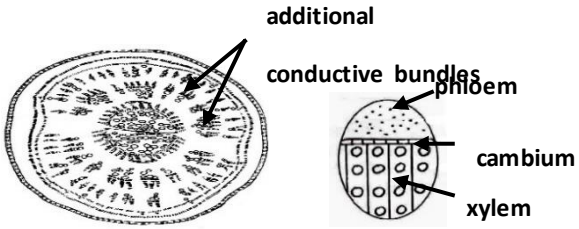
1.172. During the microscopical analysis of the root the following fact has been found: its structure is primary, cells of the endodermis are with the U-shaped thickenings of the cell walls; conductive bundle is radial type with 7 rays of the xylem. Such structure of the root is typical for …
A. **angiosperm monocot**
B. angiosperm dicot
C. gymnospermous
D. mossy
E. ferny



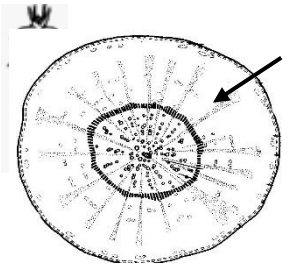
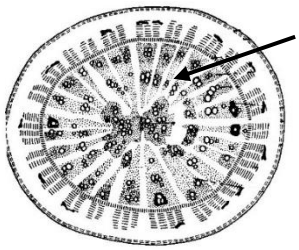
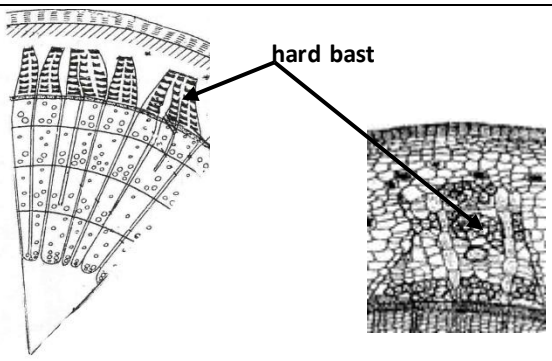
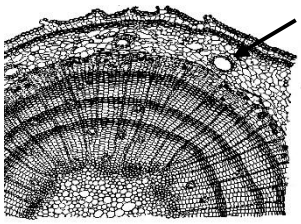
Monocot plants may have more than 6 rays of the xylem, but Dicots up to 6 and endoderm (see Fig. 1.170). The root does not have the real pith. In the centre there can be vessels of the xylem, sclerenchyma sometimes parenchyma. In Monocots and ferns the primary anatomic structure remains in the region of anchoring and conduction for the whole life.

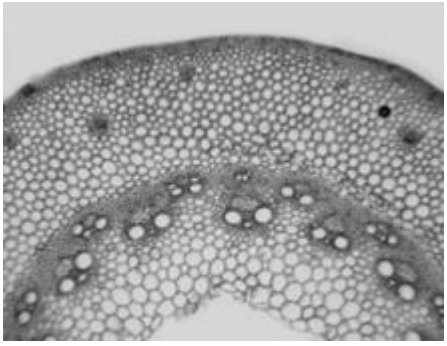
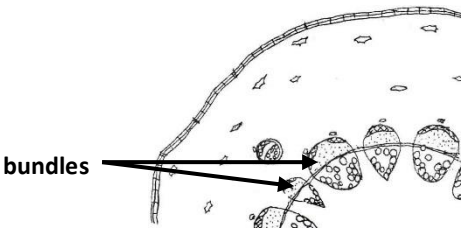
1.173. On the cross section of the beet edible root we see some rings of the cambium. They form additional conductive bundles and storage parenchyma. So, structure of this edible root is …
A. **secondary, polycambial**
B. secondary, monocambial
C. primary, polycambial
D. primary, monocambial
E. transitional, monocambial

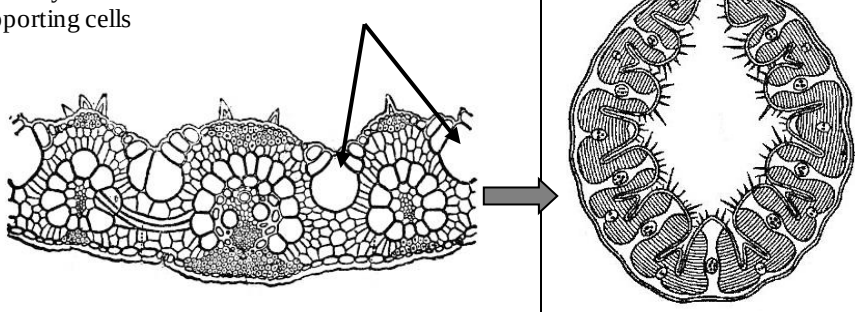
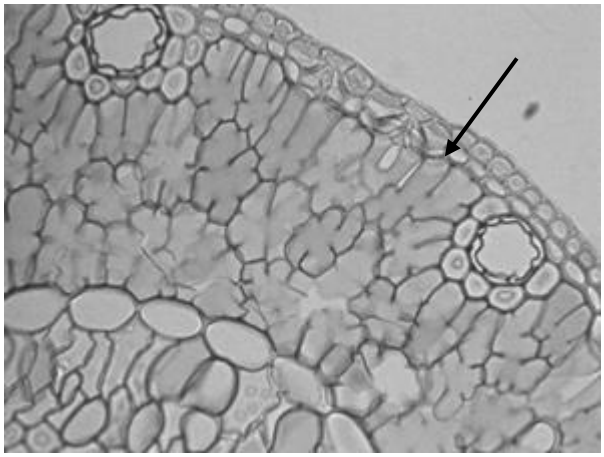




The secondary polycambial thickening of a beet storage root is provided by the cambium which forms from 2 to 18 additional rings. Cambium produces open collateral fibrovascular bundles and interfascicular parenchyma.

1.174. During the study of carrot edible structure it is observed that nutritious substances are stored in more developed, fleshy part of the organ - … A. **bast** B. primary xylem C. secondary xylem D. primary cork E. cambium	 **nutrients accumulate in cortex storage parenchyma** The secondary bark and the bast of a carrot spread especially strongly and accumulate nutrients.
1.175. The senescent root of the garden radish is not so sappy; the storage xylem is becoming harder and porous. This is a result of considerable overgrowth and lignifications of … A. **vessels** B. parenchyma C. bast fibers D. sieve tubes E. companion cells	 **nutrients accumulate in secondary xylem** The vessels of xylem enlarge their diameters with the lapse of time and lignify.
1.176. During microscopical analyses of the root cross section it is determined the following: the root has a periderm and annual rings formed by spring and autumn tracheids. Therefore, this is a root of… A. **woody gymnosperm** B. herbaceous dicot C. woody dicot D. herbaceous monocot E. woody monocot	It is typical for axes (e.g. as for roots) of woody plants the presence of secondary integumentary tissue – the periderm; and annual rings the feature of gymnosperms is the presence of tracheids in a xylem.
1.177. 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. **hard bast** B. soft bast C. spring xylema D. lamellar collenchyme E pith rays	 **hard bast** The **hard bast** representative with bast fibers and sclereids that carry out a mechanical function.
1.178. The stem studied has gum ducts, in bast there are no companion cells and in woods there are no vessels. Spring tracheids perform the conductive function and autumn tracheids – the mechanical function. These anatomic features are typical for … A. **Pinus (pine-tree)** B. Betula (birch) C. Tillia (small-leaved lime) D. Helianthus (sunflower) E. Cucurbita (pumpkin)	 **gum ducts** Gum ducts are intercellular canals in a plant for the secretion or passage of gum.

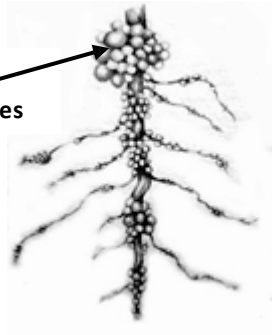
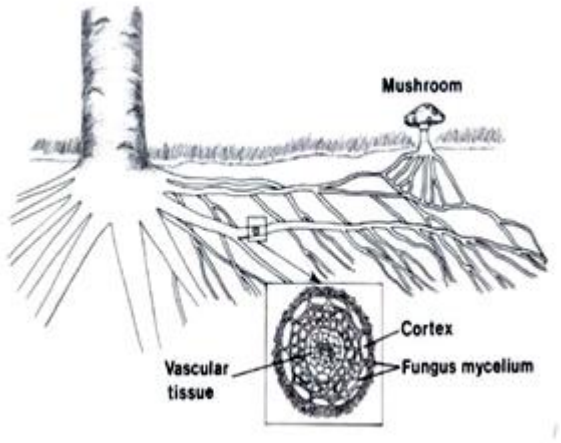
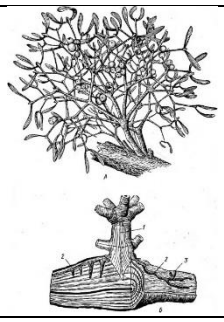
1.179. On the slice of the rhizome in the central cylinder we can distinguish closed collateral and centrophloem conductive bundles. Thus, plant belongs to the class of… A. **monocot** B. dicot C. ferny D. horse-tail E. moss	Collateral close bundls and centrophloem conductive bundles are typical for rhizom of **monocot** plants. These bundles are situated in confusion. 
1.180. On the slice of the rhizome in central cylinder we can distinguish open collateral conductive bundles are location in a circle. It helps to suppose that plant belongs to the class of… A. **dicot** B. monocot C. ferny D. horse-tail E. moss	**Rhizomes of Dicots** are similar to the stem structure, but have some differences. They are covered by loose periderm, do not contain chloroplasts; the endoderm is storage-bearing. These rhizomes have badly developed mechanical tissues, but have good developed storage parenchyma of the primary cortex. The bundles are not large, open collateral or bicollateral. 
1.181. Columnar parenchyma is adjacent to the upper epidermis of the leaf without stomata. Spongy parenchyma is adjacent to the lower one with stomata. The upper epidermis is more illuminated than the lower one. A leaf with such characteristics is... A. **dorsiventral (versatile)** B. izolateral (versatile) C. izolateral (equilateral) D radial	**Dorsiventral type** of anatomical structure of the leaf blade is characterized by the fact that palisade (columnar) layers are located under the upper epidermis of chlorenchyma and spongy layers are located under the lower one.

1.182. For lessening of evaporation the leaves of the feather grass and other steppes xerophytes convolve due to the presence of special cells in the epidermis. They are called … A. **motor cells** B. guard cells C. subsidiary cells D. secretory cells E. supporting cells 	**Motor cells** are a type of plant cells that acts like a hinge at joints to enable the movement of plant parts, such as the closing and opening of leaflets in response to light intensity or the rapid closure of a leaf in a carnivorous plant. Motor cells adjust their internal concentration of potassium ions (K+) to alter their turgidity, and hence the cell shape.
1.183. During microscopical study of the pine leaf we find that layer thick-walled cells, which carry out protective and mechanical function, is situated under epidermis. This is … A. **hypodermis** B. endodermis C. crystalliferous facing D. collenchyme E. sclerenchyma	**Hypodermis** is one or more layers of cells lying immediately beneath the epidermis in the leaves and other organs of many plants, differing morphologically from the underlying tissues. A true hypodermis develops from the 'ground meristem and therefore has an origin different from that of the epidermis as is evidenced by the noncoincidence of the anticlinal walls of the two tissues. It can implement different functions. If the layers are strongly thickened then the cells enhance the isolating properties of epidermis. Besides different biologically active substances can be accumulated in a hypoderm. 

Content module 2.
MORPHOLOGY OF THE VEGETATIVE AND GENERATIVE ORGANS

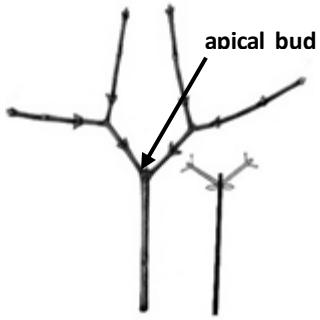
Content submodule 1.
MORPHOLOGY OF THE VEGETATIVE ORGANS
ROOT

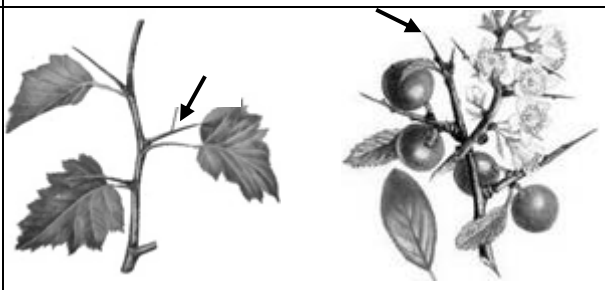
2.1. The studying of the main root ontogenesis showed that the root is generated from… A. **embryo root of the seed** B. apical meristem C. pericycle D. lateral meristem E. intercalary meristem	Embryo development and metabolism resume upon seed germination. Given the right combination of water availability, temperatures, and light, the desiccated seed begins to take up water and the embryo begins to grow and metabolize again. Some species have specific requirements for germination The root is the first portion of the plant to emerge during germination.
2.2. Investigated axial organ without nodes has radial symmetry, positive geotropism, provides mineral nutrition and fixing in the ground. This organ is … A. **root** B. stem C. leaf D. rhizome E. seed	The radicle of a germinating seed prolongates to form the primary root. The root is the non-green descending underground part of the plant axis derived from the radicle of a germinating seed. It is positively geotropic, negatively phototropic and positively hydrotropic. The root has not nodes, internodes, leaves, flowers, fruits.
2.3. From the given underground organs we choose metamorphoses of the root, namely … A. **edible root of carrot** B. tubers of potato C. rhizomes of Convallaria majalis (lily-of-the-valley) D. bulbs of garlic E. corms of saffron	 **edible root** **of the carrot** ***Edible roots*** are formed during the first year of plant's life. They are typical for biennial plants. Nutrients substances accumulate in the main root of the caroot. Also substances accumulate in lateral and additional roots.

2.4. Roots of the plants Fabaceae (Legume) Family are determined by the presence of … A. **root nodules on the roots** B. fungus-roots C. reproductive buds D. corm E. bulbs	 Some plants (e.g., plants of *Legume* Family, also alders, wolf-willow) form symbiotic relationships with certain nitrogen-fixing bacteria (e.g. *Rhizobium*). The bacteria enter the root tissues and cause the roots to form nodules. Within these nodules, the bacteria change (fix) nitrogen gas (N_2) into nitrates (NO_3), a form of nitrogen that plants can use for growth. The bacteria, in turn, use food materials manufactured by the plant.
2.5. Mycorrhiza of Quercus robur (english oak) which The studied mycorrhiza of is the symbiosis roots of higher plant with … A. **fungus** B. alga C. nitrogen-fixing bacteria D. lichen E. cianobacterium 	The word "mycorrhiza" is built from classical Greek roots. ***Myco*** means "fungus" and ***rhiza*** means "root," so the word mycorrhiza literally means "fungus-root." When the hyphae of certain fungi form specialized sheaths around the roots of certain plants, that fungal root-coating is the mycorrhiza. Having mycorrhiza on its roots improves a plant's ability to deal with droughts, to acquire mineral nutrients, to store carbohydrates, and more. These benefits are further discussed below. In the image at the right, the thicker pine-tree root is covered with mycorrhiza while the slender root at the right is not. In the drawing below you see a cross section of a root with mycorrhiza. dichotomic branching
2.6. During the study of white mistletoe, - perennial medicinal semiparasite plant, - it was revealed that its embryonic root buries into higher plant stem tissue and reaches vascular tissue system. This type of roots is called: **A. haustorial roots** B. photosynthetic roots C. aerating roots D. contractile roots E. aerial roots	

SHOOT

2.7. The apical bud of the generative shoot early stops its development, and growth and branching of the inflorescence are provided by two lateral buds, which are situated oppositely under the apex. So, shoot grows … A. **pseudodichotomic** B. equaldichotomic C. monopodialy D. unequal-dichotomic E. tillering	What is differ of the dichotomic and pseudodichotomic branching.? **Pseudodichotomic branching**: a type of branching where the apical meristem appears to divide to form two branches, one of which is dominant resulting in an upright main axis with distinct side branches (e.g., club moss club-shaped). In **dichotomic branching**, the branches form as a result of an equal division of a terminal bud (i.e., a bud formed at the apex of a stem) into two equal branches that are not derived from

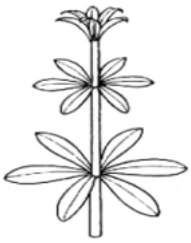
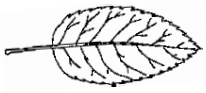
 pseudodichotomic	axillary buds, although axillary buds are present elsewhere on the plant body.
2.8. Apical bud of a sprout stops its development early and growth is realized due to two lateral buds placed opposite one another under the apex. Such ramification is called: A. **pseudodichotomic** B. nonequidichotomic C. sympodial D. monopodial E. equidichotomic	
2.9. Shoots of the Cucumis sativus (cucumber) twine around the support and climb up, so they are … A. **creeping** B. decumbent C. upright D. ascending E. climbing	Creeping plants are climbs up with help a support, clasping their. **cucumber**
2.10. Hop sprouts wind around a support and climb upwards. That means that they are: A. **creeping** B. arrect C. recumbent D. tenent E. trailing hop	

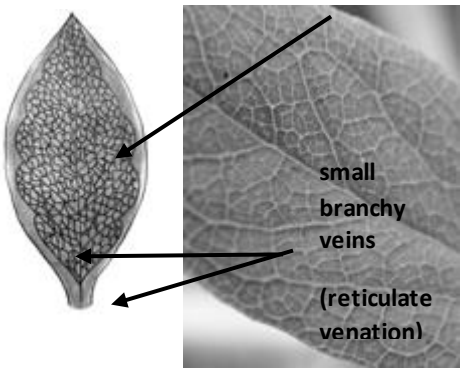
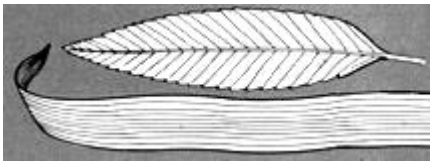
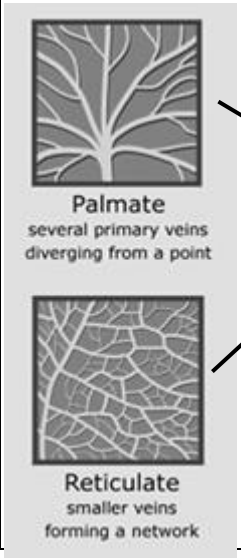
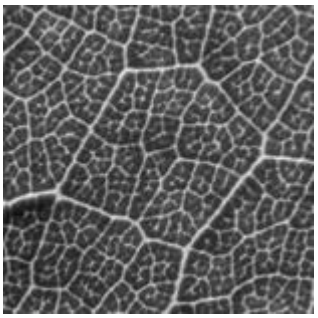
2.11. Among the given specimens of aboveground shoot metamorphoses there are such, that develop from lateral buds in leaf angle and provide vegetative reproduction. These are: A. **air bulbils** B. stolons C. bulbs D. tubers E. runners	 Air bulbils are special buds, which are developed in leaf angles. They grow up in new plants by maturation and fall down into soil.
2.12. Macroscopical analysis of the branch of the Crataegus (hawthorn) with a thorn testifies, that the thorn is a metamorphosis of the … A. **shoot** B. stipules C. leaf blade D. petiole E. cells of the epidermis	 **axillary thorn of** **apical thorn of** **Thorns** carry out protective function and are formed at lignification of apical or axillary buds, as are those of hawthorn, honey-locust, etc. Also, spines may be reduced and indurated leaves; as in the barberry, where their nature is revealed by their situation, underneath an axillary bud. But prickles, such as those of blackberry and roses, are only excrescences of the bark, and not branches.
2.13. During the investigation of the medicinal plant we find, that its underground organ has nodes, internodes, filmy leaves, buds and adventitious roots, so this is … A. **rhizome** B. edible root C. tuber D. bulb E. corm	 **Rhizome** is a characteristically horizontal stem of a plant that is usually found underground, often sending out roots and shoots from its nodes. Rhizomes may also be referred to as **creeping rootstalks** or **rootstocks**.
2.14. 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. **rhizome** B. tuber C. stolon D. storage root	

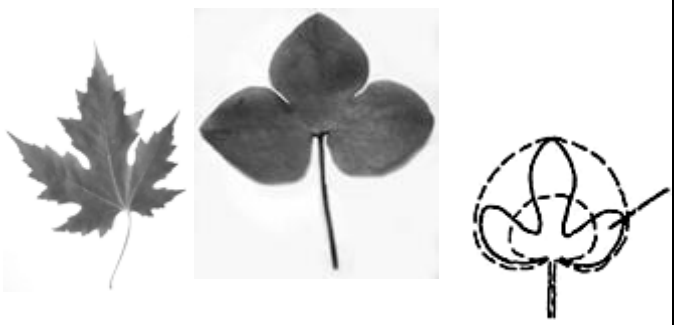
E. root bulb	If a rhizome is separated into pieces, each piece may be able to give rise to a new plant. This is a process known as vegetative reproduction and is used by farmers and gardeners to propagate certain plants. Examples of plants that are propagated this way include hops, asparagus, ginger, irises, lily of the valley, cannas, and sympodial orchids.

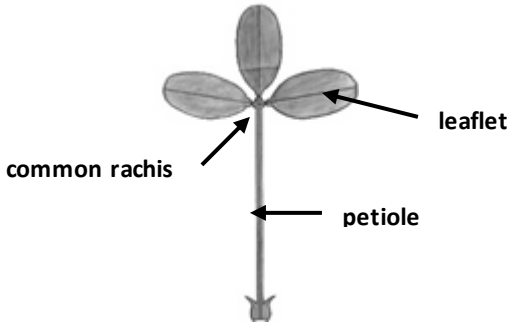
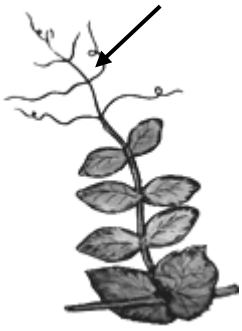
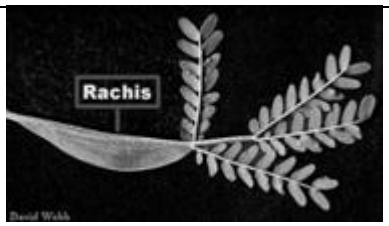
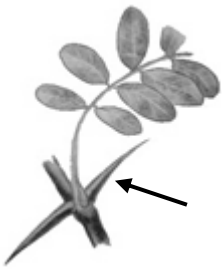
LEAF

2.15. If the prongs on the edge of the leaf blade are inclined to the top and have sides of different length, the edge of the leaf blade is... A. **serrated** B. toothed C. notched D. crenate E. wavy	**Serrated** edge of leaf blade is similar to the saw blade as prongs have different sizes and are tilted. In case of toothed edge, the sides of teeth are equal.
2.16.A phenomenon, when plants have leaves that differ as for their shape, size and degree of irregularity of the leaf blade on its stem, is called ... A. **heterophyllous** B. venation C. metamorphosis D. leaf mosaic E. modification	**Heterophyllia** is a phenomenon, when a plant has different in shape, size or degree of irregularity of the plate on its stem.
2.17. During practical field session students have detected plant with diversity of leaves that differ by their placement on stem, parts development, size, shape, lamina division. This phenomenon is called: **A. heterophylly** B. phyllotaxy C. metamorphosis D. leaf mosaic E. venation	
2.18. The Lamiaceae (Mint) Family plants have the property that couples of leafs in two neighbor node are situated in mutually antithetic planes, i.e. A. **crosswise opposite** B. distichous crosswise opposite C. whorled D. turbinal E. contortuplicate	

2.19. Each stem node of white deadnettle (Lamium album) has two leaves which grow perpendicularli to the le3aves of the previous node. Such leaf arrangement is called: A. **crosswise opposite** B. verticillate C. rosette D. leaf mosaic E. spiral	For plants of the *Lamiaceae* Family is typically crosswise opposite position of the leaves: two leaves are situated opposite and other two leaves also are situated opposite, but another plane.
2.20. If each node of the stem has more than two leaves, this leaf arrangement is... A. **whorled** B. spiral C. arranged opposite D. cross-arranged opposite E. rosette	Whorled or annular leaf arrangement is characterized by presence of more than two leaves in stem nodes. 
2.21. Leaf has one main vein from which lateral veins go away evenly. This type of venation is called … A. **pinnate** B. palmate C. arcuate D. parallel E. dichotomous	**Venation** is the name of the mode of veining, that is, of the way in which the veins are distributed in the blade. *The pinnate venation:* the main vein is expressed legibly and passes along the leaf blade in the center; the lateral veins are evenly distributed by both sides from the main vein. 
2.22. Morphological analysis of leaves revealed that each vein runs along the lamina separately and the veins join together only at the top of the lamina. This kind of venation is called: A. **arcuate** B. dichotomous C. palmate D. parallel E. pinnate	**Arcuate venation** shows that all main veins branching from along midrib, but main veins curve to follow margin of blade.
2.23. During the morphological analysis of lily-of-the-valley (Convallaria majalis) leaf it was noted that lamina has wide elliptic shape and numerous veins are parallel to leaf margin and merge only at the leaf point. What is this venation type called? **A. Arcuate** B. Parallel C. Palmate D. Pinnate-reticulate E. Dichotomous	

2.24. In the plant leaves we distinguish the central (or main) vein, from which diverge lateral veins, which branch repeatedly and make the net of small veins. So, the venation type of the leaf is … A. **pinnate-reticulate** B. arcuate C. parallel D. palmate-reticulate E. dichotomous	
2.25. While students carry out morphologic analysis of leaves of different plants, they paid attention to the leaf, in which length of the blade was 5 times longer than its width. This form of the leaf blade is called ... A. **linear** B. lanceolate C. ovoid D. kidney shaped E. elliptical	In **linear** leaf blade, the length is more than 5 times longer than its width (grass, sedge). Veins are parallel to each other and to the edge of the blade (**parallel venation**) **Lanceolate** shape is also elongated, but the blade is widened in the middle, sharpened at the top and wedge-shaped at the base.
2.26. During the morphologic analysis of various plant leaves the students found the leaves, whose length of the leaf blade is 5 times more than its width. Specify the shape of the leaf blade: **A. Linear** B. Elliptical C. Lanceolate D. Ovoid E. Reniform	
2.27. Leaf venation in monocotyledonous plants typically is... A. **parallel** B. pinnati-edge C. pinnati-reticular D. palmati-loop E. palmati-reticular	
2.28. The leaves are peltate; 5-7 similar veins spread from the plate base and branch repeatedly. So, such venation is... A. **palmately reticulate** B. palmately-edge C. parallel D arcuate E. pinnately-reticulate	If lateral veins of palmate or peltate leaf branch repeatedly, interconnect and form dense net, this venation is called **palmately reticulate** .   palmately reticulate venation

2.29. The leaf has oblong leaf blade, which is cut into the lobes up to 1/3 of the leaf size, so the leaf is … A. **pinnatilobate** B. pinnatipartite C. pinnatisected D. palmatisected E. palmatisected 	The divided leaves as for their form of the blade, location and number of the free parts are distinguished as pinnate (free parts are situated by both sides of the vein). As for the degree of the blade irregularity leaves are subdivided into lobed (irregularity is more than 1/3, but less than 1/2 of the semi blade).
2.30. 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	**Tripartite- or palmatipartite** leafs have a 3 or 5 free parts - lobes (free parts are situated radially). 
2.31. 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. **palmatisected** B. pinnatipartite C. pinnatisected D. palmatipartite E. palmatilobate	**Palmatisected** leaves have a rounded form and segmented as much as possible to the base of the leaf-blade. Dissected (cut into segments with the size from 2/3 to the main vein or base).
2.32. When analysing the officinal raw material it has been determined that leaves are cut up to the base of the blade, its segments are situated fan-like. So, these leaves are … A. **palmatisected** B. pinatisected C. palmatipartite D. pinatipartite E. palmatilobate	

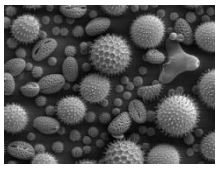
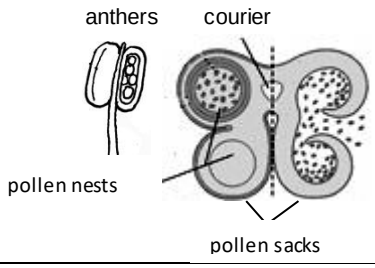
2.33. A leaf consists of three leaflets situated on the top of common petiole (rachis). This leaf is … A. **tricompound** B. trisected C. palmatisected D. paripinnately compound E. imparipinnately compound	**Tricompound** leaf has common petiole is called *rachis*. Three leaflets attach to the common rachis. 
2.34. Leaves of the *Aesculus hippocastanum* consist of 5-7 leaflets, which are situated on short rachis of the common petiole. So they are ... A. **palmately compound** B. pinnately compound C. pinnatisected D. palmatisected E. palmatilobate	**Palmately compound** leaf of *Aesculus hippocastanum* consists of 5-7 leaflets, located at the apex (rachis) common petiole.
2.35.A representative of the Legume family has a leaf with common petiole (rachis) with five pairs of opposite leaflets and one apical. So, the leaf is ... A. **imparipinnately compound** B. paripinnately compound C. palmately compound D. pinnatisect E. palmatisected. 	Pinnately compound leaves have rachis - common petiole; leaflets are located in pairs. If there is only one leaflet at the top of the leaf, this leaf is called **imparipinnately compound.**
2.36. Leaves of the pea (Pisum sativum) are attached to prop with the help of tendrils. These tendrils are metamorphoses of … A. **leaflets of the compound leaf** B. petiole of the compound leaf C. simple leaves D. petioles E. stipules	 **Leaflets of the compound leaf** of the *Pisum satiivum* modify into flexible tendrils. This is metamorphoses related supporting function.
2.37. Leaves of bastard acacia (Acacia) have overgrown flat petioles, which perform the photosynthesis function. They are called … A. **phyllodes** B thorns C. tendrils D. cladodes E. pitcher leaves	 **Phyllodes** are expanded flattened photosynthetic flat petioles, which take on the function of a leaf blade.
2.38. In the morphological study of the plant it is observed that at the base of the compound leaf there are paired thorns, they are metamorphosis of the … A. **stipules** B. leaflets C. rachises D. petiolules E. petiole	 Modified **stipules** are geminate thorns situated at the base of a leafstalk. This is metamorphoses related protective function.

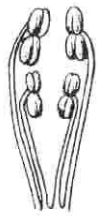
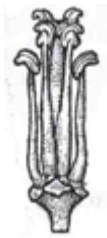
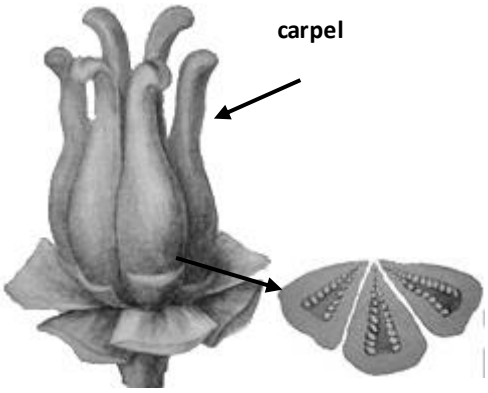
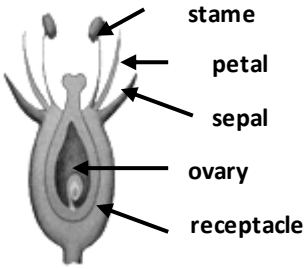
2.39. In the process of morphological description of Salvia, students paid attention to bright bracts, which serve to attract pollinating insects and are modification of: A. **leaves** B. androecium C. shoots D. pedicles E. receptacle	A cover leaf, or bract, is a **leaf,** which has a flower in its axil. It differs from vegetative leaves by its shape, size, color, pubescence, etc.

Content submodule 2.

MORPHOLOGY OF THE GENERATIVE ORGANS

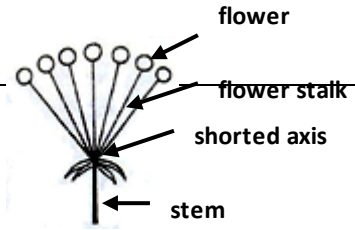
FLOWER

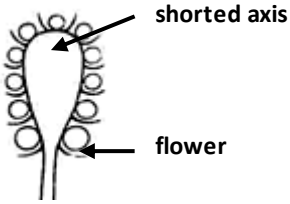
2.40.Interior bright or white part of the double perianth, which consists of petals, is called aureole or ... A. **corolla** B. calyx C. androeceum D. gynoeceum E. perigonium	**Corolla** attracts pollinators and protects internal parts. It consists of brightly colored or white free petals, spirally arranged in one or more circles (freepetalous corolla) or connated (gamopetalous corolla)
2.41. Flowers of the lily of the valley have 6 white leaflets which are grown together into the ladybell-shaped corolla. This perianth is … A. **simple corolliform** B. simple calyciform C. double D. double with corolliform calyx E. double with calyciform calyx	 Perianth is called **simple corolliform** (or corollaceous) if it has only coloured petals.
2.42. Corolla is zygomorphous, gamopetalous and consists of tuber and two free parts – upper is formed by two and lower by three accrete petals. Corolla of such type is … A. **bilabiate** B. unilabiate C. larva-form D. thimble-form E. ligulate	**Bilabiate** corolla is gamopetalous and has two lips. Generally the upper lip is narrow and the lower lip is broad. e.g., *Mentha piperita* (peppermint).
2.43. The male gametophyte of flowering plants is … A. **pollen grain** B. carpel C. embryo sac D. ovule E. nucellus 	**Pollen** is a fine to coarse powder containing the ***microgametophytes*** of seed plants, which produce the male gametes (**sperm cells**). Pollen grains have a hard coat that protects the sperm cells during the process of their movement between the stamens to the pistil of flowering plants or from the male cone to the female cone of coniferous plants. **Stamen** consists of a stamen filament, a connective and an anther, the main part of the stamens. An anther is composed of two pollen sacs joined by a connective: a plate of different shapes on the top of stamen filament. Processes of microspores forming occur in anther. Owing to the mitosis process, microspores form the male gametophyte called pollen.
2.44. Sporiferous structures of the flower, which have two pollen sacs joined by a connective, form flower's ... A. **anther** B. pestle C. stigma D. ovary E. style 	

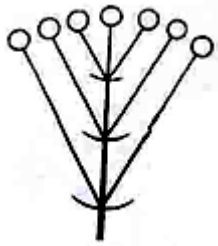
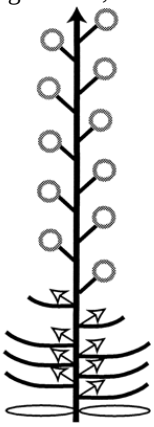
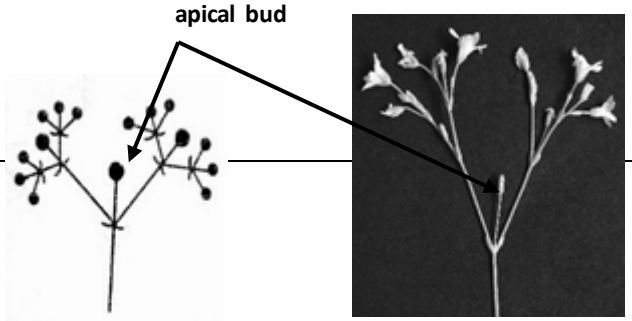
2.45. Androecium was considered in the flower. It consists of two long and two short stamens. So, androecium of the flower is … A. **didymous** B. tetradymous C. diadelphous D. tetradelphous E. polyadelphous	 The stamen is male reproductive part of a flower. Together, the stamens are called as **androecium**. Stamens can also be free or joined from more than one whorl, also called adnate. **Didynamous** androecium is occurring in two (2 and 2) pair's stamens having different length.
2.46. Flowers of *Brassica oleracea* (cultivated cabbage) have four long stamens and two – short. So, the type of the androecium is … A. **tetradymous** B. didymous C. monoadelphous D. diadelphous E. polyadelphous	 **Tetradymous** androecium is occurring in two (4 and 2) pair's stamens having different length.
2.47. The flower has many stamens that accrete by stamen filaments in several bunches, so androecium is … A. **polyadelphous** B. tetradymous C. didymous D. monoadelphous E. diadelphous 	 **Polyadelphous** androecium has many stamens, which grow together into bundles (e.g. *Hypericum perforatum*).
2.48. In adonis *(Adonis vernalis)* flower gynoecium consists of numerous free carpels, i.e. it is … A. **apocarpous** B. monocarpous C. syncarpous D. paracarpous E. lysicarpous	An ***apocarpous gynoecium*** is few or many simple pistils, they are free or slightly accrete. 
2.49. Dissected flower has an inferior ovary, since the pistil is … A. **cenocarpous, receptacle is concave, accrete with ovary** B. cenocarpous, receptacle is concave, not accrete with ovary C. monocarpous, receptacle is concave, not accrete with ovary D. monocarpous, receptacle is flat, not accrete with ovary E. monocarpous, receptacle is convex, not accrete with ovary	 An **inferior ovary** lies below the attachment of other floral parts. The location of ovary is inferior if the walls of the pistil ovary grow together with concave receptacle. Flowers with inferior ovaries are termed **epigynous**.
2.50. A shortened axis of the flower with strongly connivent nodes, where other parts of the flower are located in rings or spirals, forms flower's ... A **receptacle** B pedicel C perianth	**Receptacle** is an extended shortened main axis of the flower with strongly connivent nodes. All parts of the flower are located on it. Its shape may be flat, convex, and concave of various degrees. If concave receptacle is connated with the base of sepals and filaments, it forms hypanthium.

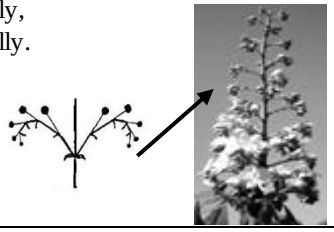
D calyx E corolla	

INFLORESCENCES

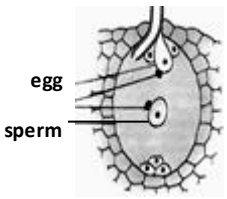
2.51. The common feature of the inflorescences of plantain *(Plantago major)* (spike) and maize *(Zea mays)* (spadix) is the presence of sessile flowers on the well developed main axis, which grows monopodialy, it is typical for inflorescences - … A. **botryoid simple** B. botryoid compound C. cymose D. aggregate E. thyrsus	**Botryoid** (or monopodial) inflorescences (e.g., spadix, head, anthodium) is a kind of definite simple inflorescence. The main shoot nonbranching. *A spadix* - the main axis is vertically lengthened, thickened, the flowers are sessile. *A spike* - the main axis is lengthened; the flowers are sessile, alternate.
2.52. Monopodial inflorescences of plantain (spike) and maize (ear) have one trait in common: their flowers are placed on the well-developed principal axis. This is typical for the following inflorescences: A. **simple botrioid** B. thyrsus C. complex botrioid D. cymose E. aggregate	 Botryoid is a simple inflorescence ending in a flower of a floral bud; includes raceme, spike, umbel and other variants.
2.53. Leafed inflorescence of the marsh mallow (*Althaea officinalis*) has the well developed main axis where flowers are situated on the short flower stalk in turn. This is … A. **raceme** B. umbel C. corymb D. panicle E. dichasium	A ***raceme*** – the main axis is lengthened, flowers on the pedicles. **raceme**
2.54. Acorus calamus has inflorescence, which consists of numerous small sessile flowers, situated on the thick fleshy axis. So, this is … A. **spadix** B. spike C. umbel D. corymb E. head	A **spadix** is a type of spike inflorescence having small flowers borne on a fleshy stem. Spadix are typical of the *Araceae* Family known as arums or aroids.
2.55. Examination of an inflorescence of sweet flag Acorus calamus L. revealed that it was encircled with a covering leaf (spathe) and small sessile flowers grew compactly on the thickened pulpy axis. Such inflorescence is called: **A. ear** B. glomus C. spike D. umbel E. corymb	
2.56. The cherry-tree (Cerasus vulgaris) has shorted main axis of inflorescence, its pedicles are approximately of the equal length, and they grow from one point. This is typical for inflorescence - … A. **umbel**	An **umbel** is a type of raceme with a short axis and multiple floral pedicels of equal length that appear a common point. 

B. corymb C. raceme D. spike E. anthodium	
2.57.A sour cherry has shortened principal axis of inflorescence, pedicles have nearly equal length and emerge like from the same point. It is typical for the following type of inflorescence: **A. umbel** B. corymb C. truss D. ear E. anthodium	
2.58. Inflorescence of Ledum palustre has a significantly shortened rachis, connivent nodes, pedicles of the quite similar length. This inflorescence is called: **A.umbel** B. glomus C. bostryx D. spike E. ament	
2.59. The plant examined has simple inflorescence with the short-cut and thickened axis, where flowers are situated on the short flower stalks. This inflorescence is … A. **head** B. bostryx C. catkin D. corymb E. anthodium	*A **head*** - the main axis is shortened, thickened; the flowers are on the very short pedicles (e.g., clover). 
2.60. The flowers of milk vetch (Astragalus dasyanthus) sit on the shorted and thickened main axis, forming simple inflorescence, which is called ... A. **glome** B. corymb C. catkin D. panicle, E. spike	
2.61. Inflorescence of greater plantain grows out at apex, the main axis is long, and flowers are sessile. This type of inflorescence is called: **A. spike** B. panicle C. spadix D. capitulum E. thyrsus	
2.62. During the field practice the student determined the plant, which had inflorescence with the horizontal overgrown axis, sessile flowers and leaf involucre, so this inflorescence is … A. **anthodium** B. spike C. corn D. glome E. panicle	*An **anthodium**,* or ***calathium*** - the main axis horizontally overgrows in a common receptacle; the flowers are sessile, small, with the characteristic of the corolla's types. Around the inflorescence there is one- or multiserial involucre from bracts.

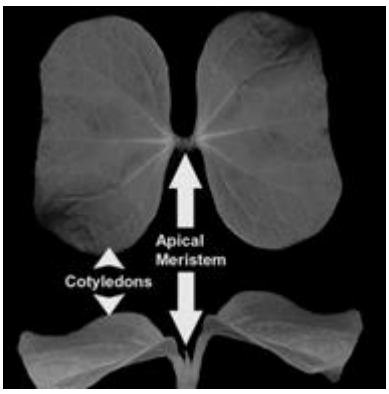
2.63. During the field practice a student found a plant with disk-shaped structure of its rachis, sessile flowers and husk. This inflorescence is called: **A. anthodium** B. spike C. spadix D. glomus E. raceme	
2.64. The flowers which form inflorescence are attached to a single axis at different levels. However, because of different pedicle lengths the flowers lie at the same plane and form … A. **corymb** B. calathidium C. head D. umbel E. bostryx	*A **corymb*** - the main axis is more or less well developed, the flowers are alternate and the pedicles of the lower flowers are longer than at the overhead ones, that is why the flowers are almost at one level (e.g., pear, hawthorn). 
2.65. In the inflorescence of wild rosemary (*Ledum palustre*) the main axis is shorted, the nodes are brought together; flowers are situated approximately on the same level. So, this inflorescence is … A. **corymb** B. clove C. bostryx D. spike E. catkin	
2.66. Flowers, which form inflorescences, have pedicles different length, and so flowers lie in the same plane and form … A. **corymb** B. calathidium C. head D. umbel E. bostryx	
2.68. Leafed inflorescence of the marsh mallow (*Althaea officinalis*) has the well developed main axis where flowers are situated on the short flower stalk in turn. This is … A. **raceme** B. umbel C. corymb D. panicle E. dichasium	*A **panicle*** - they are abundantly branching out axes of the following orders, bearing flowers 
2.69. The apical bud of the generative shoot early stops its development, and growth and branching of the inflorescence are provided by two lateral buds, which are situated oppositely under the apex. So, shoot grows … A. **sympodialy, according to the type of the dichasium** B. dichotomic C. monopodialy	Dichasium is sympodial inflorescence which finished with apical flower. Two lateral buds are situated oppositely under the apical flower bud. 

D. sympodialy, according to the type of the monochasium E. sympodialy, according to the type of the pleiochasium	
2.70. Inflorescence of the *Chelidonium majus* (rock poppy) has abbreviated main axis, which ends by apical flower and has some development lateral axes, equal in length, and situated in circles. So, that inflorescence is called … A. **false umbel (or pleiochasium)** B. simple umbel C. head D. bostryx E. compound umbel	 **A pleiochasium (or false umbel)** - the lateral axes of the following order are located verticillate, carry flowers. The main axes ended by apical flower.
2.71. The birch has compound male and female inflorescences, the main axis is drooping. It consists of dichasiums of unisexual flowers. So, inflorescence of the birch is … A. **compound catkin** B. raceme C. catkin D. spike E. glome	 A **compound catkin** is a thyrsoid unisexual, generally drooping inflorescence. It consists of 3-5 male or female flowers which are composed into dichasiums (e.g., birch, oak).
2.72. Combined inflorescence of horse chestnut has main axis growing monopodially and the lateral ones, growing sympodially. Such features are typical for ... A. **thyrsus** B. panicle C. complex corymb D. compound umbel E. compound spice	In thyrsus, or nonhomogeneous composite inflorescence, its major axis grows monopodially, and side ones grow sympodially. In horse chestnut, lateral inflorescences are the tendrils, and in birch, they are dichasias. 

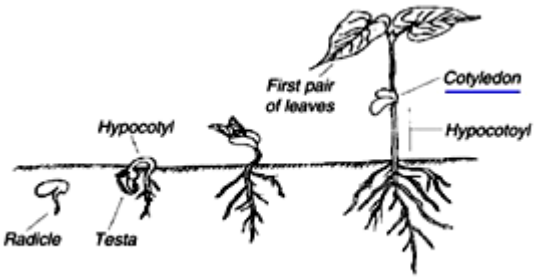
FRUIT

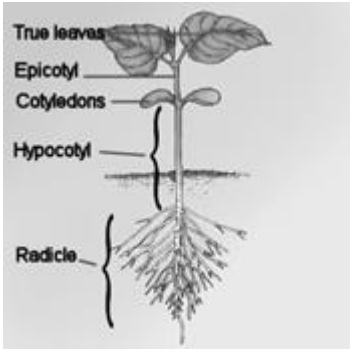
2.73. Navashin S.G., a Ukrainian biologist, found that during double fertilization of the flower one spermatozoon fused with the central nucleus of the embryo sac, and the other with ... A. **egg** B. synergids C. antipodes D. nucellus E. chalaza	Double fertilization is sexual flowering process involving two sperm piltsevogo grain (male gametophyte). One sperm fuses with the egg to form a diploid zygote, which gives the embryo seed. The second sperm cell fuses with the central cell of the embryo sac, forming a triploid zygote from which the endosperm is formed. 
2.74. It is determined, that in the seed without endosperm and perisperm nutrients are accumulated in the …	

A. **cotyledon of the germ**
B. embryonic root
C. embryonic stem
D. embryonic bud
E. skin of seed



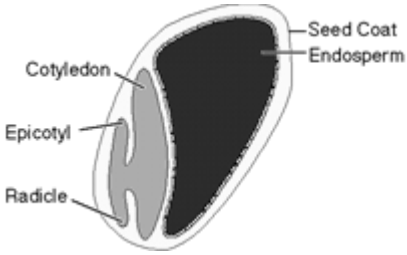
The nutrients can accumulated in the endosperm, perisperm and **cotyledon of the germ**.



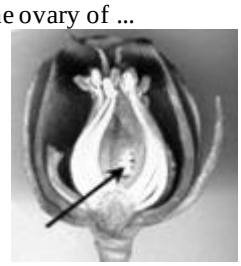


2.75. The seed part of the flowering plan is investigated; it forms from triploid zygote and contains nutrients. This part is
A. **endosperm**
B. cotyledons
C. embryonic root
D. embryonic bud
E. seed cover

Endosperm is the tissue produced inside the seeds of most flowering plants around the time of fertilization. It surrounds the embryo and provides nutrition in the form of starch, though it can also contain oils and protein.

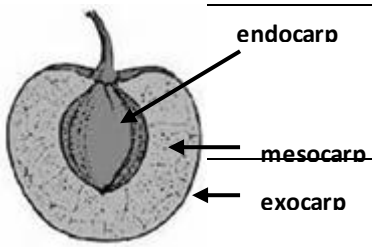


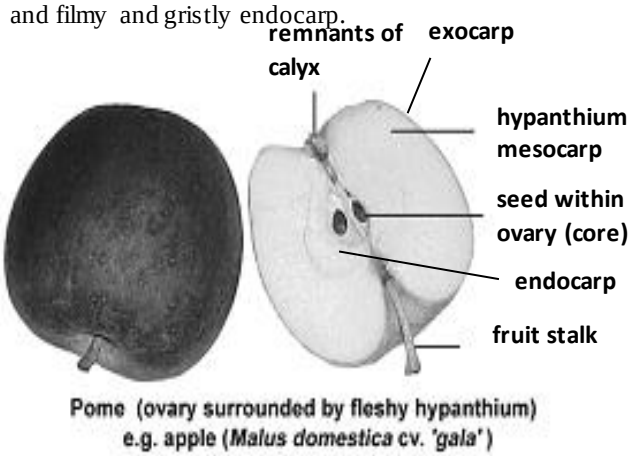
2.76. Seed embryo develops in the ovary of ...
A. **pistil**
B. stamens
C. sepals
D. petal
E. receptacle



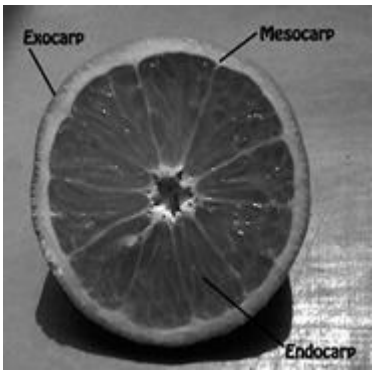
A **pistil** is a female reproductive part of the flower. It consists of an ovary, a column and a stigma.
The ovary is a lower, extended, hollow part of the pistil that contains seeds rudiments.
After fertilization, the ovary walls form pericarp.

2.77. We have selected monocarpous one-seeded fruit, its endocarp is lignificated, with sclereids, and mesocarp is fleshy. This is …
A. **drupe**
B. legume

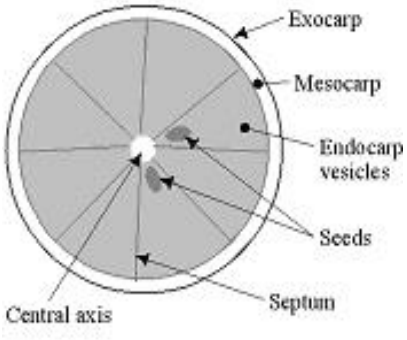


C. silique D. fruitcase E. berry	
2.78. You need to specify a monocarpous one-seeded fruit with hard scleroid endocarp and soft mesocarp. This fruit is: A. **monodrupe** B. bacca C. capsule D. silique E. legume	***Drupe*** is indehiscence; one-seeded, pericarp consists of exocarp (peel), fleshy mesocarp and endocarp (or stone) (e.g., cherry, apricot).
2.79. During the study the flower it is observed that pistil is formed by one free carpel. So, gynoecium is called … A. **monocarpous** B. apocarpous C. cenocarpous D. lysicarpous E. syncarpous	Some angiosperms have only a single carpel per flower. These have a monocarpous gynoecium.
2.80. Select the fruit that meets the description: monocarpic, dry, polyspermous, can be split apart only in the ventral suture. The seeds are located along the ventral suture: A. **follicle** B. drup C. dry stone fruit D. fleshy fruit E. coccus	 ***Follicle*** is dry, explosive along the ventral suture, it is many-seeded (e. g. larkspur).
2.81. Fleshy false cenocarpous fruit of the *Rosaceae* (Rose) Family is formed from hypantium and inferior ovary. Seeds are surrounded by cartilaginous endocarp. This is … A. **pome** B. silicle C. achene D. silique E. fruitcase	***Pome*** is formed from the inferior ovary at overgrowth of the hypantium. It has dense exocarp, fleshy mesocarp and filmy and gristly endocarp. 
2.82. During analyzing the fruits we determine that one of them has glandular exocarp, spongy mesocarp and grown endocarp, which looks like juicy sacks. This fruit is … A. **hesperidium** B. legume C. silique D. drupe E. berry	A **hesperidium** (plural **hesperidia**) is a modified fruit with a tough, leathery rind. The peel contains volatile oil glands in juicy sacs. The fleshy interior is composed of separate sections, called carpels, filled with fluid-filled vesicles that are actually specialized hair cells. The outer ovary wall becomes the thick spongy layer (*exocarp*), while the inner ovary wall (*mesocarp*) becomes very juicy (*endocarp*) with several seeds.

2.83. What is the type of a fruit with the following properties: many-seeded, indehiscent, with a juicy pericarp, it is produced from cenocarpous gynoecium:
A. **hesperidium**
B. silique
C. phraga
D. cynarodium
E. coenobium



2.84. Fruits of the genus citrus are used for receiving essential oil. Fruit consists of orange exocarp, white spongy mesocarp and fleshy endocarp. This is …
A. **hesperidium**
B. pepo
C. fruitcase
D. pome
E. silique

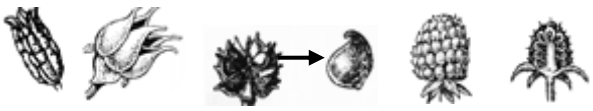


2.85. The fruit is cenocarpous, seeded, indehiscent, its exocarp is more or less hard, dense, sometimes lignified, meso- and endocarps are juicy include overgrown placenta. It is...
A. **pepo**
B. berry
C. pome
D. granatum
E. hesperidium

Pepo is a fruit of the *Cucurbitaceae* family of plants (cucumber, pumpkin). It is formed from the bottom of ovary, and an overgrown placenta is involved in its formation. Placenta is a part of the ovary that has ovules attached to it.

2.86. Fruits belonging to apocarpous ones are...
A. **complex drupe, manyleaflet**
B. capsule, berry
C. legume, nutlet
D. pome, acorn
E. cremocarp, kalatch

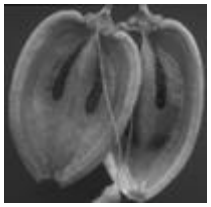
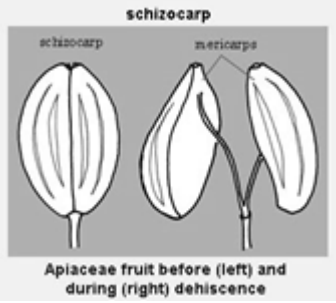
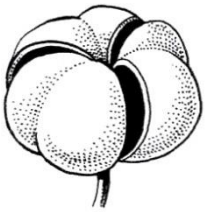
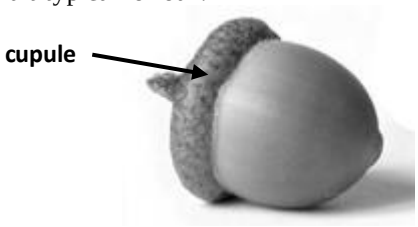
Apocarpous (prefabricated or complex) fruits are formed by several free fruitlets of the apocarpous gynoecium.

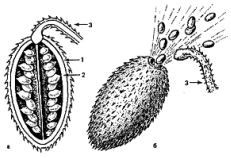


2.87. During the morphological analyses of the fruit it is determined, that it is dry, cenocarpous, multilocular, many-seeded, and dehiscent on the seams.
This fruit is a …
A. **fruitcase**
B. legume
C. polyfollicle
D. follicle
E. silique

poppy fruitcase

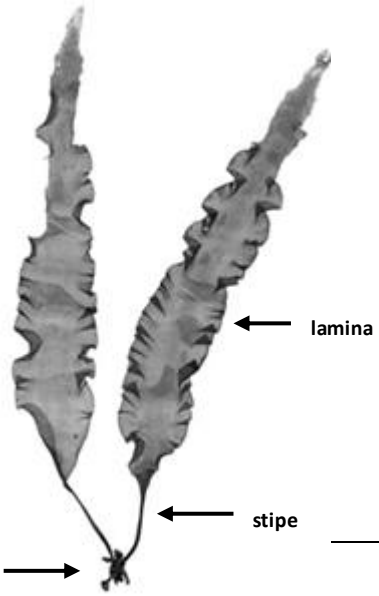
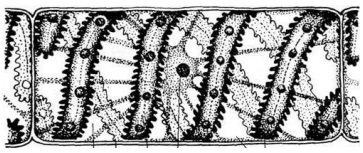
Fruitcase (or capsule) is dry, many-seeded fruit, which is formed from superior (e.g., *Solanaceae* family) or inferior ovary (e.g., campanula, iris).

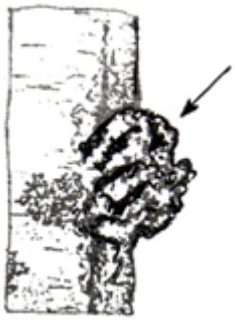
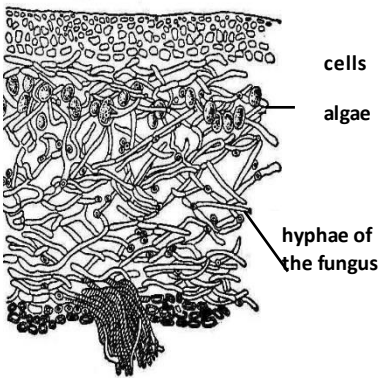
2.88. Select the type of a fruit by the following properties: a coenocarp fruit whose mericarps have 5 axial main edges between which secondary edges can be contained. A lot of ethereal oils are contained in the ethereal channels of its pericarp. A. **cremocarp** B. cypsela C. nut D. legume E. silique 	**Cremocarp** is a dry dehiscent fruit consisting of two indehiscent one-seeded mericarps which separate at maturity and remain pendant from the carpophore. Cremocarp is fruit of the *Apiaceae* (Carrot) Family. 
2.89. Fruit of wild radish is formed by two carpels, separated by false membranous septum, where seeds are located. After maturation it splits into segments. This is a ... A. **jointed follicle** B. kalatch C. coenobium D. capsule E. disamara	Fruit dissects on two sutures or dehiscence into joints (**loment silique).**
2.90. Investigated plant has box-shaped schizocarp fruit, which comes apart into three explosive mericarps when maturated. This is … A. **regma** B. cremocarp C. tetranutlet D. hesperidium E. capsule (or fruitcase)	 **Regma** is a dry fruit consisting of three or more carpels that separate from the axis at maturity.
2.91. A one-seeded fruit is pseudomonocarpous with a lignificated pericarp. The seed accretes not with the pericarp. This is … A. **nutlet** B. silicle C. achene D. silique E. pseudomonocarpous drupe	**Pseudomonocarpous** is fruit who form from cenocarpous gynoecium but developed out of one carpel only. **Nutlet** is indehiscent fruit it is one-seeded (e. g., greater burnet).
2.92. A fruit under examination is pseudomonocarpic, with woody pericarp and one seed. The seed cuticle remains unfused with the pericarp. Such fruit is called: **A. nut** B. cremocarp C. achenocarp D. caryopsis, E. pseudomonocarpic drupe	
2.93. A one-seeded nuciform fruit cracks not by maturation. It has acorn cup, which is formed by overgrowth and lignification of the flower stem and bracts. This is … A. **acorn** B. nut C. nutlet D. disamara E. corn seed	**Acorn** is formed with tree carpels, from the inferior ovary. Pericarp is skinny. Acorn has cup-shaped cupule which is formed from the imbricated, accrete, skinny leaflets. Acorn is fruit typical for oak. 

2.94. Morphological analysis of fruits shows that they are a combination of ripe fruits, formed from flowers of a single inflorescence. They are ... A. **multiple fruits** B. polydrupes C. regmas D. hesperidiums E. capsules	Compound fruit is a set of mature fruits and of cauline constituent parts of a tight inflorescence that is clearly separated from the vegetative part of the shoot.
2.95. Specify the type of seed distribution, when during their maturation fruits crack and the seeds are ejected with strength. A. **autochore** B. hydrochore C. geochore D. zoochore E. anemochore 	**Autochore** is distributiob of fruit, seeds, and spores without participation of external factors. They distinguish different forms of autochore: active scattering of seed from a cracked ripe fruit under the pressure (mechanochore) like **squirting cucumber (Ecballium)**, pumpkin family; burying fruit into the soil (geocarpy); spreading the fruits and seeds under action of gravity (barochore).

Content module 3.
PLANT SYSTEMATIC

ALGAE, FUNGI, LICHEN

3.1. The brown alga with trunk, rhizoids, and foliaceous part is rich in alginates and iodine is ranked with genus of: A. **Laminaria** B. Chlorella C. Ulothrix D. Chlamydomonas E. Spirogira ***Laminaria saccharina***  	***Laminaria*** is a genus of 31 species of brown algae (Phaeophyceae), all sharing the common name "kelp". They grow in White Sea and other. This economically important genus is characterized by long, leathery laminae and relatively large size. The greater proportion of commercial cultivation is for algin, iodine and mannitol, which are used in a range of industrial applications. The largest producer of kelp products is China
3.2. It is kn division hav chromatophores. Band-shaped chromatophores are species of the genus... A. **spyrogyra** B. volvox C. clorella D. chlamidomonas E. spirulina 	Plastids of algae are chromatophores in the form of a green band, spirally located; freshwater filamentous green alga Spyrogyra (Spirogyra) Division Chlorophyta has them.
3.3. The studied cells have nucleus and do not have chloroplasts; their cytoplasm reserves glycogen, the cell walls contain chitin. So, the cells belong to… A. **fungi** B. lichen	**Fungi**, which is separate from plants, animals, and bacteria. One major difference is that fungal cells have cell walls that contain chitin, unlike the cell walls of plants, which contain cellulose. A fungi cell has hard

C. alga D. higher plant E. cyanobacteriae	shell, whose main structural substance is chitin; it also contains proteins, fats, polyglucanes.
3.4. The structure of gill-bearing hymenophore is considered by way of example of poisonous pileate fungus from the Basidiomicota class – A. **fly agaric** B. champignon C. shelf fungus D. ergot E. polypore	 **Basidiomycota** is one of two large phyla that, together with the Ascomycota, comprise the subkingdom Dikarya (often referred to as the **"higher fungi"**) within the Kingdom Fungi. Fly-Agaric (*Agaricus muscarius*) is inedible poisonous mushroom having the red cap with white dots and stalk.
3.5. A sterile form of xylotroph Inonotus obliquus (i.e. shelf fungus) is detached from a trunk of Betula pendula. In other terms this is: A. **polypore** B. fly agaric C. ergot D. champignon E. tinder fungus 	***Inonotus obliquus***, commonly known as **Chaga mushroom** is a fungus in Hymenochaetaceae family. It is parasitic on Birch and other trees. The sterile conk is irregularly formed and has the appearance of burnt charcoal. It is not the fruit body of the fungus, but a big mass of mycelium, mostly black due to the presence of massive amounts of melanin. The fertile fruit body can be found very rarely as a resupinate (crustose) fungus on or near the clinker, usually appearing after the host tree is completely dead. Chaga mushroom being used in folk medicine Eastern European countries as a remedy for cancer, gastritis, ulcers, and tuberculosis of the bones.
3.6. The representatives of this Division reproduce vegetatively by means of special formations: Isis, soredia, lubul.These organisms are from Division... A. **lichenes** B. basidiomycota C. equisetophyta D. lycopodiophyta E. polypodiophyta 	**Lichens (Lichenes)** is symbiotic organisms that consist of a fungus (marsupial, basidiomycete) and algae (green, blue-green). Reproduce vegetatively by body parts or special formations - Isis, soredia, lobul.

SPORE-BERING PLANTS

3.7. The highest cryptogams have the ability to produce spores at the process of asexual reproduction. This is one of adaptations for living in upland. What is the chromosome set for spores? A **haploid** B. diploid C. triploid D. tetraploid E. polyploidy	At all sporous plants in their life cycle of development have alternation of generation – sexual and unisexual. The sexual generation is prothallium (or gametophyte). Gametophyte is formed from spores. Gametophyte has haploid a set of chromosomes. It carries out function of formation of gametes in special organs of sexual reproduction, which called amphigonium and antheridium. The asexual generation (or sporophyte) is formed of a zygote. Sporophyte has diploid a set of chromosomes. It carries out function of formation spores in special organs, which called sporangium.
3.8. A higher nonvascular plant has precise heterogenesis, where gametophyte is dominant (sexual generation) and	**Bryophyta (Mosses)** are small, soft plants that are typically 1–10 cm (0.4–4 in) tall, though some species are

sporophyte (unisexual generation) is reduced. So, a plant belongs to…

A. **bryophyta (mosses)**
B. lycopodiophyta (club mosses)
C. equisetophyta (horsetails)
D. polipodiophyta (ferny)
E gymnospermae (conifers)

much larger. They commonly grow close together in clumps or mats in damp or shady locations. They do not have flowers or seeds, and their simple leaves cover the thin wiry stems. At certain times mosses produce spore capsules which may appear as beak-like capsules borne aloft on thin stalks.

3.9. The plant with phylloids and rhizoids has no natural conductive tissues; its gametophyte is dominating in the development cycle. So, this plant belongs to...

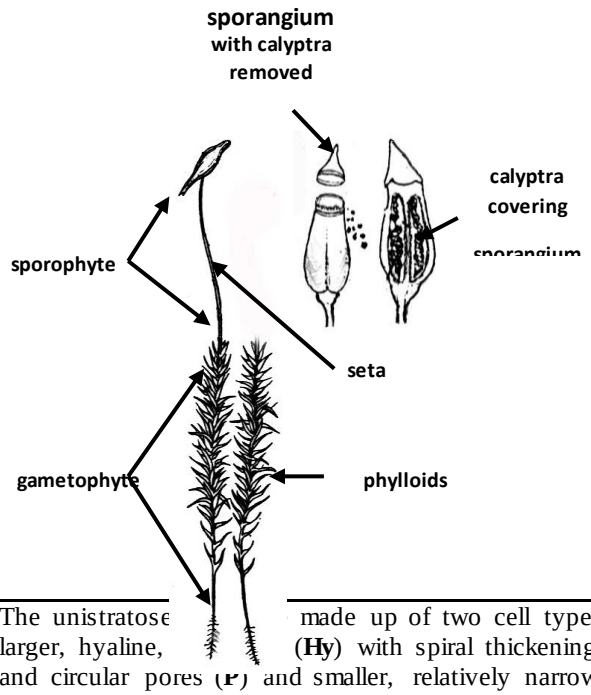
A. **bryophyta**
B. lycopodiophyta
C. equisetofyta
D. polypodiophyta
E. gymnosperme

Mosses are bryophytes, or non-vascular plants is differ from 'higher' plants by not having internal water-bearing vessels or veins, and no flowers and therefore no fruits, cones or seeds. They are small (a few centimeters tall) and herbaceous (nonwoody) and absorb water and nutrients through their leaves. Mosses have stems which may be simple or branched and upright simple leaves that often have midribs, roots (rhizoids) that anchor them to their substrate, and spore-bearing capsules on long stems.

In addition to lacking a vascular system, mosses have a gametophyte - dominant life cycle, i.e. the plant's cells are haploid for most of its life cycle. Sporophytes (i.e. the diploid body) are short-lived and dependent on the gametophyte.

3.10. The subkingdom Embryophytes incorporates various groups of eucaryotes with the common feature of ability to photosynthesis. One can observe in their biocycle the heterogenesis alternation of sporophyte and gametophyte generations. What is the division of plants for which the gametophyte dominates the sporophyte in the life cycle?

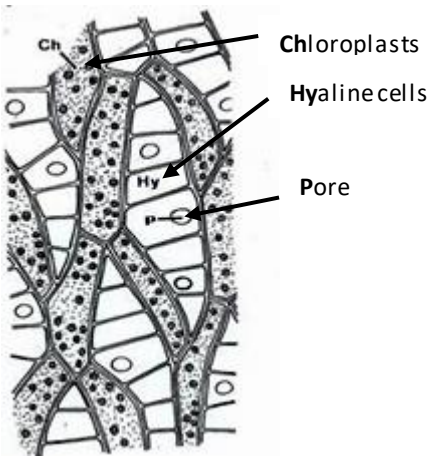
A. **bryophyta**
B. magnoliophyta
C. pynophyta
D. lycopodiophyta
E. polypodiophyta



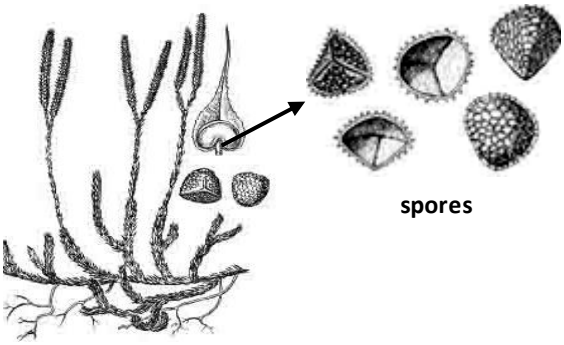
3.11. Sphagnum possesses quick absorbability and strong water retention because …

A. **there are special hyaline cells**
B. alive near reservoirs
C. presence of roots
D. absence of transpiration
E. a leave surface has a dense layer of cutin

The unistratose [illegible] made up of two cell types: larger, hyaline, [illegible] (**Hy**) with spiral thickenings and circular pores (**P**) and smaller, relatively narrow, elongated cells that contain chloroplasts (**Ch**) and surround the hyaline cells; a midrib is lacking.



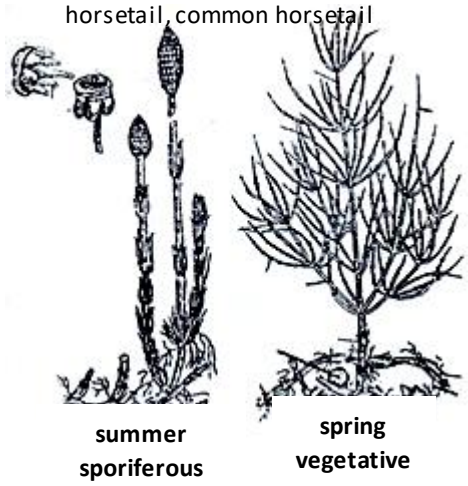
sphagnum

3.12. Spores of a higher plant are used as a powder for children. This plant is … A. **lycopodium clavatum** B. equisetum arvense C. pinus sylvestris D. ledum palustre E. calendula officinale	Previously spores are used as powder in medicine (in children practice). 
3.13. Spore and pollen analysis revealed in the pollen some tetrahedral spores with a semi-circular base and a reticular surface, which may belong to: **A. lycopodiophyta** B. equisetiphyta C. bryophyta D. polypodiophyta E. pinophyta	

3.14. The plant which was investigated has a rhizome, spring nonchlorophyllic brown sporiferous shoots and summer green vegetative shoots. This is…

A. **Equisetum arvense**
B. Polytrichum commune
C Dryopteris filix mas
D. Lycopodium clavatum
E. Ephedra distachium

Equisetum arvense L., field horsetail, common horsetail



Equisetum arvense (**Field Horsetail** or **Common Horsetail**), is a herbaceous perennial plant, native throughout the arctic and temperate regions of the northern hemisphere. It has separate sterile non-reproductive and fertile spore-bearing stems, growing from a perennial underground rhizomatous stem system. The fertile stems are produced in early spring and are non-photosynthetic, while the green sterile stems start to grow after the fertile stems have wilted, and persist through the summer until the first autumn frosts.

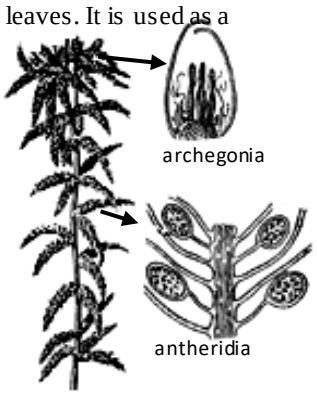
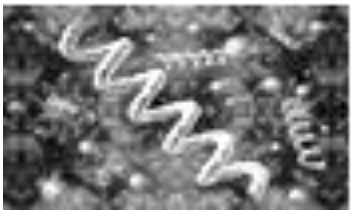
3.15. A plants under examination has a rhizome, big pinnatisected leaves with sori and sporangia on their undersurface . According to this data the plant should be related to one of the the following divisions :

A. **Polypodiophyta**
B. Lycopodiophyta
C. Magnoliophyta
D. Pinophyta
E. Eguisetophyta

3.16. The sporophyte of the studied plant is a rhizome perennial. The plant frond leaves are pinnatisected; they have soruses with spores on the underside. The plant belongs to division…

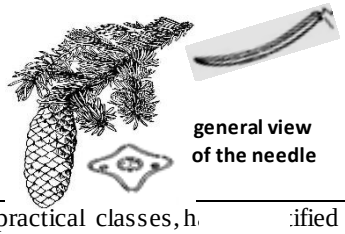
A. **Polypodiophyta**
B. Bryophyta
C. Lycopodiophyta
D. Equisetofyta
E. Gymnosperme

Polypodiophyta is division of the Plant kingdom consisting of the plants commonly called ferns. The ferns are vascular plants with stems, roots, and leaves. The small and inconspicuous gametophyte and the large spore-producing fern plant are quite independent of each other. The sporophyte plant, which is the plant form popularly recognized as a fern, may have an erect stem of more than 50 ft (16 m) in height, or a prostrate stem lying in or on the ground. Typically, the leaf, or frond, is large and much divided, although many ferns have simple leaves, i.e., leaves with the blade undivided. Fern leaves generally unroll as they develop from a coiled early bud stage is called the fiddlehead. Sporangia, the spore-producing structures, are generally found on the back of the leaf, but occasionally occur on special structures, which are probably evolutionarily modified leaves. In the great majority of ferns, the spore cases, or sporangia, are produced in groups, with each group called a sorus. These sori can often be seen on the back of the leaves. The sporangia in the sorus are usually protected in some manner, sometimes by an umbrellalike structure, the indusium, and sometimes by the inrolling of the leaf edge. The sporangium consists of a jacket of thin cells, partly surrounded at one side by a row of very thick-walled cells, the annulus. When the spores are mature, a springlike mechanism in the annulus serves to tear open the sporangium and eject the spores.

3.17. On the marshland we have collected Sphagnum palustre. Its stems are branched without rhizoids, leaves are arranged spirally imbricated, between the leaves of lateral branches there are antherids, and on the tips of shoots there are archegonias. This generation of sphagnum is... A. **monoecious gametophyte** B. dioecious gametophyte C. sporophyte D. protonema E. sporogonia	**Sphagnum palustre** is white, or peat moss, with dominant monoecious gametophyte, able to absorb and retain large amounts of water in its leaves. It is used as a hygroscopic material. 
3.18. Spirulina – is usual as a dietary supplement, a source of complete protein and vitamins. So it is a representative of the division ... A. **cyanobacterium** B. green algae C. diatoms D. askomicotus E. zigomicotus	**Arthrospira platensis** is filamentous cyanobacteria (blue-green alga), living in alkaline lakes. Contains up to 70% of protein, normalizes metabolism and makes up for the deficiency of vitamins and minerals. 

GYMNOSPERMOUS

3.19. A conifer has soft, bright-green needles collected in a bunch on the short shoots. Every year in autumn these leaves fall down. It indicates that this tree belongs to the genus … A. **Larix (larch)** B. Abies (abies) C. Pinus (pine) D. Picea (spruce) E. Cedar (cedrus) 	***Larix*** – larch, family – ***Pinaceae,*** Division – ***Pynophyta*** *Larix* (Larch) is coniferous tree at which fall down leaves - the soft needles collected in bunches on shortened shoots. Although a conifer, the larch is a deciduous tree and loses its leaves in the autumn. The shoots are dimorphic, with growth divided into long shoots typically 10–50 centimetres long and bearing several buds, and short shoots only 1–2 mm long with only a single bud. The leaves are needle-like, 2–5 centimetres long, slender (under 1 cm wide). They are borne singly, spirally arranged on the long shoots, and in dense clusters of 20–50 needles on the short shoots. The needles turn yellow and fall in the late autumn, leaving the trees leafless through the winter.

3.20. The subkingdom Embryophytes consists mainly of terraneous organisms which are presented by various life forms (herbs, shrubs, subshrub, trees and others). What is the division of Embryophytes which includes only shrubs and trees? A. **Pynophyta** B. Magnoliophyta C. Bryophyta D. Lycopodiophyta E. Polypodiophyta	**Pines** are trees in the genus ***Pinus*** in the family Pinaceae. The division of *Pynophyta* is presented only by bushes and trees.
3.21. The main diagnostical feature for distinguishing the species of pine-tree is quantity of needles on the shortened shoots. The pine-tree has … A. **two needles** B. five needles C. three needles D. eight needles E. many needles	The main diagnostical feature for distinguishing the species of pine-tree is quantity of needles on the shortened shoots. The pine-tree has only **two needles** on the shortened shoots.
3.22. One of the important diagnostic characters for determining of pine species is the number of acerose leaf (needles). What is this number for common pine? A. **2** B. 5 C. 3 D. 8 E. many	
3.23. A common species of the Pinaceae family is an evergreen, shade tolerant, high tree. Its needles are tetrahedral, short, hard, barbed, spirally arranged. This is... A. **Picea abies** B. Larix sibirica C. Pinus sylvestris D. Juniperus communis E. Ephedra equisetina  	Diagnostic features of **Picea abies** (Norway spruce) include short, hard, prickly tetrahedral spirally arranged needles.
3.24. Students, in their practical classes, h ified gymnosperms with dark blue cones, covered with a waxy bloom. This is... A. **Juniperus communis** B. Thuja occidentalis C. Taxus baccata D. Abies sibirica E. Cedrus libani 	**Juniperus communis** (common juniper), Cypress Family. Medicinal raw materials are cones, roundish three seminal dark blue cones coated grown together juicy scales.

ANGIOSPERMS
The Brassicaceae Family

3.25. Flowers of *Brassica oleracea* (cultivated cabbage) have four long stamens and two – short. So, the type of the androecium is …
A. **tetradymous**
B. didymous
C. monoadelphous
D. diadelphous
E. polyadelphous

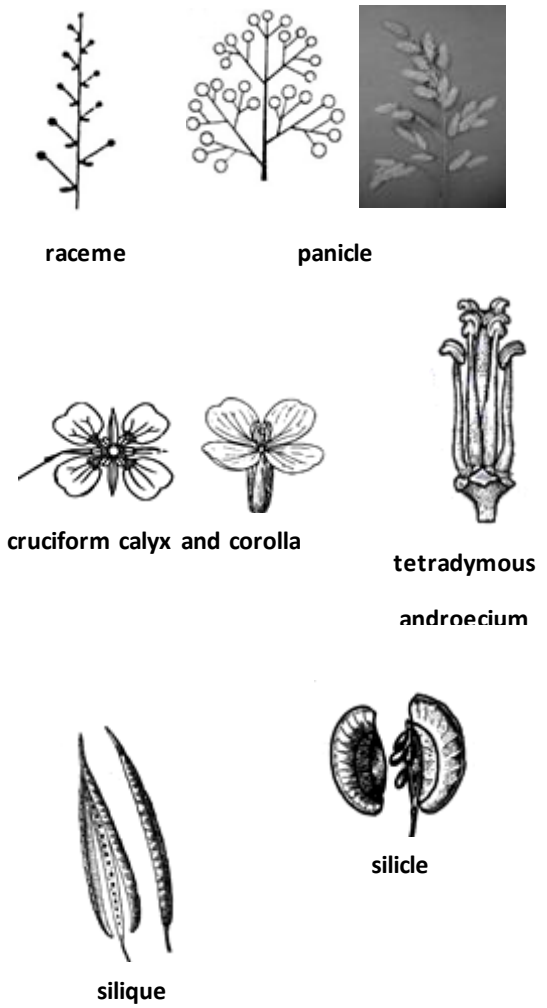
3.26. Plants which have flowers with cruciform calyx and corolla, tetradymous androecium and fruits – silique and silicle, are typical for family …
A. **Brassicaceae (Mustard)**
B. Solanaceae (Potato)
C. Fabaceae (Legume)
D. Apiaceae (Carrot)
E. Scrophulariaceae (Figwort)

3.27. According to the presence of typical features - cruciform (or cross-shaped) calyx, tetradymous androecium, and fruit silicle, plant belongs to the …
A. **Brassicaceae (Mustard) Family**
B. Solanaceae (Potato) Family
C. Apiaceae (Carrot) Family
D. Fabaceae (Legume) Family
E. Rosaceae (Rose) Family

3.28. The morphological comparison of the plants of *Brassicaceae* (Mustard) Family shows that most of the representatives have small flowers gathered in inflorescences - …
A. **raceme, panicle**
B. corymb, umbel
C. glom, anthodium
D. spadix, spike
E. compound umbel

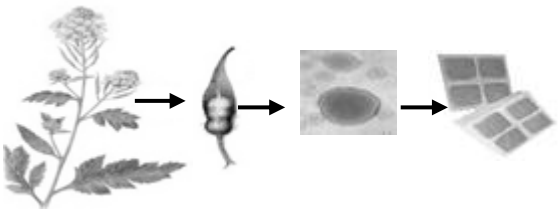
3.29. Small yellow flowers of the Brassicaceae (Mustard) Family plant aggregate in inflorescence, which is called …
A. **raceme, panicle**
B. corymb, umbel
C. head, anthodium
D. spike, spadix
E. compound umbel, compound corymb

The *Brassicaceae or Cruciferae* (Mustard) Family
Diagnostic features of the *Brassicaceae* Family



3.30. Seeds of the *Brassicaceae* (Mustard) Family plants have poignant taste and used for production of the mustard plasters and fatty oil. These seeds are taken from such plants as …
A. **Brassica nigra (black mustard), Sinapis alba (white mustard) and Brassica juncea (chinese mustard)**
B. Brassica oleracea (cabbage), Brassica nigra (black mustard) and Brassica juncea (chinese mustard)
C. Capsella bursa-pastoris (shepherd's purse), Sinapis alba (white mustard) and Brassica juncea (chinese mustard)
D. Brassica nigra (black mustard), Capsella bursa-pastoris (shepherd's purse) and Sinapis alba (white mustard)
E. Erysimum canescens (treacle mustard), Brassica nigra (black mustard) and Brassica juncea (chinese mustard)

The seeds of *Brassica nigra* (black mustard), *Sinapis alba* (white mustard) and *Brassica juncea* (chinese mustard) *Brassicaceae* (Mustard) Family plants are used for production of the mustard plasters and fatty oil



3.31. By comparison of five medicinal plants it is determined that one of them belongs to the *Brassicaceae* (Mustard) Family, namely …

A. **Erysimum canescens (erysimum)**
B. Rosa canina (dog rose)
C. Arctostaphylos uva-ursi (bearberry)
D. Urtica dioica (great nettle)
E. Polygonum aviculare (knot grass)

Erysimum canescens (erysimum)
The Brassicaceae or Cruciferae (Mustard) Family Herb of *Erysimum canescens* and its preparations – for treatment of blood flow disorder, heart disease, cardiosclerosis, as sedative, diuretic.

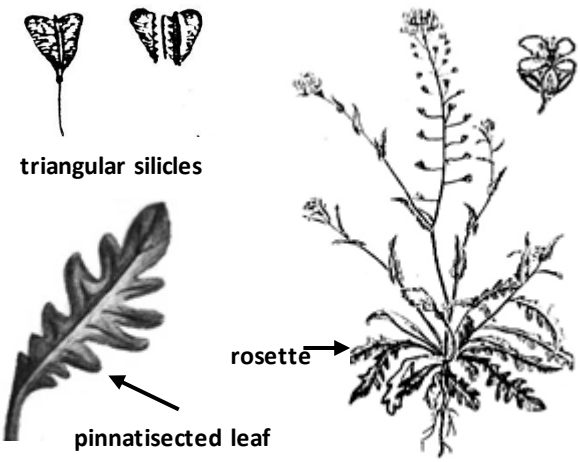
3.32. Among the samples of the plants we determine the species that belongs to the *Brassicaceae* (Mustard) Family. This is …

A. **Erysimum canescens (treacle mustard)**
B. Ledum palustre (marsh tea)
C. Salvia officinalis (garden sage)
D. Taraxacum officinale (dandelion)
E. Calendula officinalis (pot marigold)

3.33. *Capsella bursa-pastoris* (shepherd's purse) is annual plant, which has …

A. **pinnatisected and pinnatipartite leaves and triangular silicles**
B. entire leaves and roundish silicles
C. pinnatilobate leaves and cylindrical siliques
D. pinnately compound leaves and loment siliques
E. pinnatipartite leaves and cylindrical siliques

Capsella bursa-pastoris (shepherd's purse)
The Brassicaceae or Cruciferae (Mustard) Family

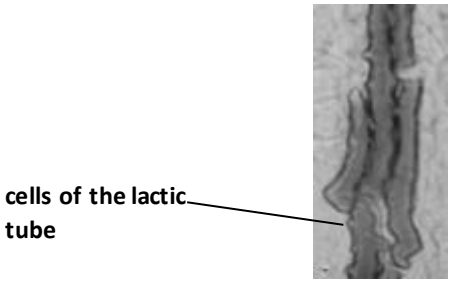


Pinnatisected leaf - cut up to the main vein of the blade or to the base.
Pinnatipartite leaf - the free parts are equal ½ of the semi blade and more)
Silicle is fruit, which has length equal to its width.

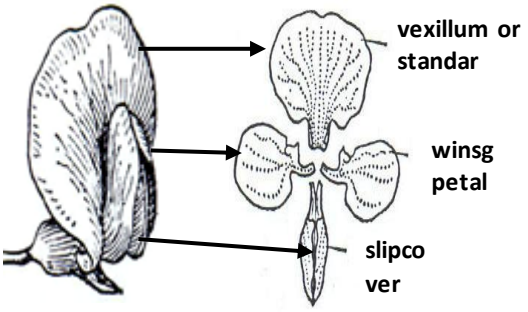
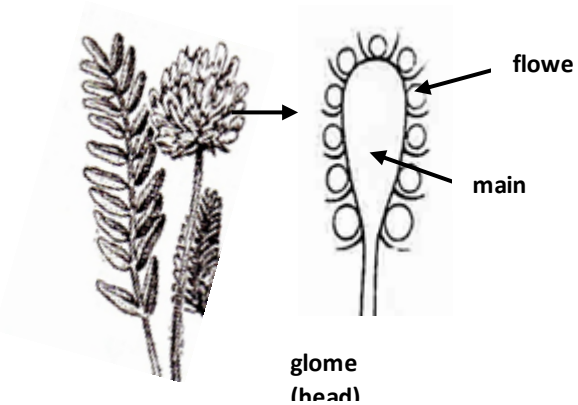
Capsella bursa-pastoris (shepherd's purse) use for treatment of blood flow disorder, travma and other.

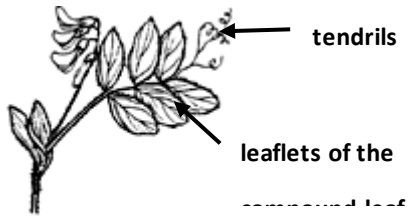
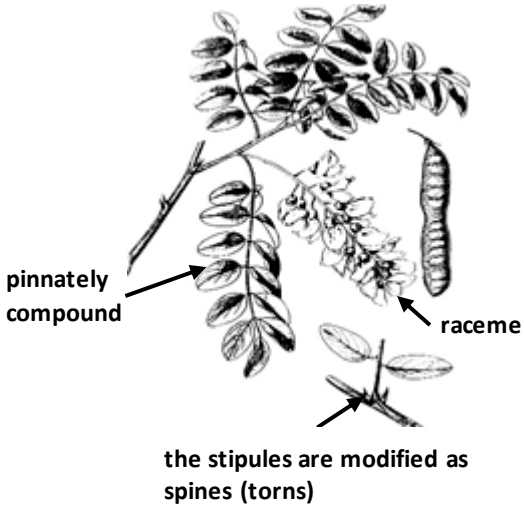
3.34. A fruit of plants of the Cabbage Family has approximately the same length and width, consists of two flaps and false membranous septum on both sides of which the seed is located. This fruit is - ... A. **silicle** B. legume C. berry D. achene E. samara	

The Papaveraceae Family

3.35. The determinated medicinal plant has a pistil formed with big quantities of carpels; its fruit is fruitcase which dehisce by small holes. This is … A. **Papaver somniferum (opium poppy)** B. Chelidonium majus (rock poppy) C. Zea mays (maize) D. Mentha piperita (peppermint) E. Sanguisorba officinalis (greater bumet)	**Fruitcase** (or capsule) of the **poppy** is cenocarpous, dry, many-seeded fruit, which is formed from superior ovary and explosive by holes.
3.36. The plant from the Poppy Family contains milky sap of yellow coloring, it has umbel-shaped inflorescence, flowers with deciduous calyx and 4 yellow petals. This is … A. **Chelidonium majus (rock poppy)** B. Robinia pseudoacacia (black locust) C. Papaver somniferum (opium poppy) D. Taraxacum officinale (dandelion) E. Glaucium flavum (yellow horned poppy)	All parts of the *Chelidonium majus* (rock poppy) contain orange latex in the lacticifers.
3.37. Investigated plant of the *Papaveraceae* (Poppy) Family has lacticifers with yellow and orange latex in all its organs. It's typical for … A. **Chelidonium majus (rock poppy)** B. Ranunculus acris (species of buttercup) C. Adonis vernalis (spring vernalis) D. Papaver somniferum (opium poppy) E. Aconitum napellus (aconite)	

The Fabaceae Family

3.38. Investigated flowers have papilionaceous type of the corolla. This is plant belong to the … Family. A. **Fabaceae (Legume)** B. Scrophulariaceae (Figwort) C. Ranunculaceae (Buttercup) D. Lamiaceae (Mint) E. Asteraceae (Sunflower)	The plants of *Fabaceae* (Legume) family have only papilionaceous flowers, which consist of some parts. There is: one large of the petal, which is called *vexillum*, two lanceolata, separate petals, which are called *wings* and two united petals which are called *keel*. 
3.39. One of the plants under examination has a zygomorphic flower and papilionaceous corolla. This plant is called: **A. Melilotus officinalis** B. Mentha piperita C. Valeriana officinalis D. Urtica dioica E. Rosa canina	
3.40. A plant has compound leaves and papilionaceous flowers, its fruit is legume. Most probably it belongs to the family … A. **Fabaceae** B. Scrophulariaceae C. Ranunculaceae D. Lamiaceae E. Asteraceae	Legume is monocarpous, dry, explousive or not explousive frut. legume
3.41. The flowers of *Astragalus dasyanthus* (milk vetch) sit on the shorted and thickened main axis, forming simple inflorescence, which is called ... A. **glome** B. corymb C. catkin D. panicle E. spike	Inflorescens with the shorted and thickened main axis, forming simple inflorescence is called **glome (head).** 

3.42. Astragalus dasyanthus has sessile flowers gathered into inflorescences with a short thick axis. This inflorescence is called: **A. capitulum** B. cyme C. truss D. spike E. head	
3.43. Leaves of the *Pisum sativum* (pea) attach to prop with help of the tendrils. These tendrils are metamorphoses of … A. **leaflets of the compound leaf** B. petiole of the compound leaf C. simple leaves D. petioles E. stipules	*Pisum sativum* (pea) of *Fabaceae* (Legume) family  The top leaflets of comlex leaf are modified in tendrils. With their help the plant is attached to a support. The stipules can be overgrowing into large photosynthesis leaves.
3.44. The representative of the *Fabaceae* Family has pinnately compound leaves, stipules, modified as spines, and a droop white raceme. This is … A. **Robinia pseudoacacia (black locust)** B. Artemisia vulgaris (mugwort) C. Aronia melanocarpa (black chokeberry) D. Pisum sativum (garden pea) E. Quercus robur (english oak)	*Robinia pseudoacacia* (black locust) of *Fabaceae* (Legume) family 
3.45. The fruit of black locust is dry, formed of a single carpel, dehisces by the ventral and dorsal sutures on two sides, the seeds are attached along the ventral suture. Such fruit is called: **A. Legume** B. Siliqua C. Follicle D. Capsule E. Silicula	
3.46. Comparative analysis of 5 medicinal plants of *Fabaceae* (Legume) Family discovers that 4 of them have tricompound leaves, and the 5th has pinnately compound leaves. This plant is … A. **Robinia pseudoacacia (black locust)** B. Melilotus officinalis (sweet clover) C. Glicine hispida (soya bean) D. Ononis arvensis (restharrow) E. Phaseolus vulgaris (kidney bean)	*Glycyrrhiza glabra* (sweet root) of *Fabaceae* (Legume) family

3.47. Plant of *Fabaceae* (Legume) Family has well developed rhizome with roots and stolons, pinnately compound leaves with 5 or 7 pairs egg-shaped, glandulosous leaves, and friable and axillary racemes. Flowers are faintly – violet. Legumes are indehiscent. Underground organs are used as expectorant drug and for improvement of the drug taste. This plant is …

A. **Glycyrrhiza glabra (sweet root)**
B. Melilotus officinalis (sweet clover)
C. Robinia pseudoacacia (black locust)
D. Ononis arvensis (restharrow)
E. Astragalus dasyanthus (milk vetch)

3.48. At the medicinal pectoral collection we discover brightly yellow pieces of the root with a sweet taste. It is determined that this root is of the …:

A. **Glycyrrhiza glabra (licorice)**
B. Althea officinalis (sweatweed)
C. Acorus calamus (sweet flag)
D. Valeriana officinalis (common valerian)
E. Sanguinea officinalis (greater burnet)

3.49. While studying 5 herbarium specimens of medicinal plants, it is determined that one plant belongs to *Fabaceae* (Legume) Family, namely …

A. **Glycyrrhiza glabra (licorice)**
B. Atropa belladonna (belladonna)
C. Hyoscyamus niger (poison tobacco)
D. Datura stramonium (datura)
E. Solanum tuberosum (potato)

3.50. While studying 5 herbarium specimens of medicinal plants, it was determined that one plant belong to the *Fabaceae* (Legume) Family namely …

A. **Mellilotus officinalis**
B. Atropa belladonna
C. Hyoscyamus niger
D. Datura stramonium
E. Solanum tuberosum

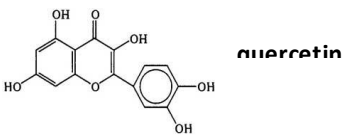
Mellilotus officinalis
of *Fabaceae* (Legume) family

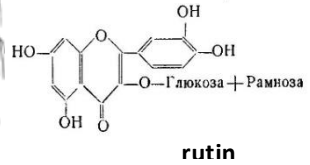
3.51. The industrial source of rutin and of quercetin is flowers of a plant from the *Fabaceae* (Legume) Family:

A. **sophora japonica**
B. locust pseudo-acacia
C. caragana
D. astragalus
E. silver wattle acacia

The flowers *of Sophora japonica* (*abaceae* (Legume) family) are industrial source of rutin and of quercetin.

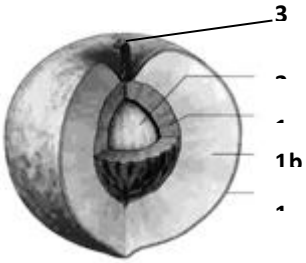
Rutin can be used to treat hemorrhoids, varicosis, and microangiopathy.

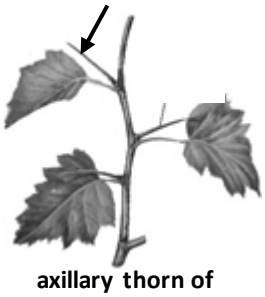




	Quercetin is sometimes promoted to help prevent or treat different types of cancer. It has also been promoted to help with the symptoms of chronic prostatitis (swelling of the prostate gland) and to relieve some of the neurologic complications of diabetes.

The Rosaceae Family

3.52. One of the common features of the representatives of subfamily Prunoideae from the *Rosaceae* (Rose) Family is that their fruit is … A. **drupe** B. aggregate -accessory C. berry D. apple E. pepo 	**Drupe** is monocarpous fruit. Monocarpous (or simple) fruits are formed from the monocarpous gynoecium and cosist of next part: 1 - pericarp: *a - exocarp;* *b - mesocarp;* *c - endocarpp* 2 - semen (or seed) 3 - pedicle (or fruit stem)
3.53. Fleshy false cenocarpous fruit of the *Rosaceae* (Rose) Family is formed from hypantium and inferior ovary. Seeds are surrounded by cartilaginous endocarp. This is … A. **pome** B. silicle C. achene D. silique E. fruitcase	
3.54. A fruit-tree of the *Rosaceae* Family has short-cut thorny shoots; its fruit is pome of characteristic shape and has stone cells in the pulp. This is… A. **Pyrus communis (pear-tree)** B. Malus domestica (apple) C. Cerasus vulgaris (cherry-tree) D. Armeniaca vulgaris (apricot-tree) E. Prunus domestica (plum-tree)	***Pyrus communis* (pear-tree)** representative subfamily Maloideae has a fruite pome with a specific pyriform**.**
3.55. Which of the following plants has pome fruits? A. **Sorbus aucuparia** B. Amygdalus communis C. Prunus padus D. Prunus domestica E. Rosa majalis 	***Sorbus aucuparia*** of the representatives of subfamily Maloideae from the *Rosaceae* (Rose) Family is that their fruit is a small pome - 6–9 mm (rarely up to 14 mm) diameter, green at first, ripening bright red in late summer, and containing up to eight (most commonly two) small seeds.

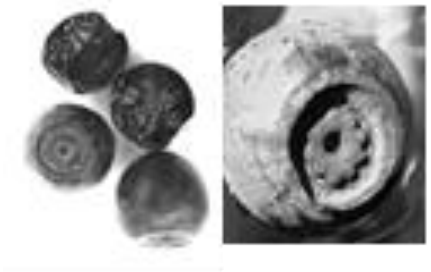
3.56. Among the plants studied a berrylike pome is typical for the species of … A. **Aronia mellanocarpa (black chokeberry)** B. Prunus spinosa (blackthorn) C. Rosa canina (dog rose) D. Padus racemose (bird cherry) E. Amygdalus communis (common almond)	 Some pomes may have a mealy texture (e.g., some apples); others are berry-like with juicy flesh and a core that is not very noticeable.
3.57. The macroscopical analysis of the branch of the *Crataegus* (Hawthorn) with a thorn testifies that the thorn is a metamorphosis of the … A. **shoot** B. stipules C. leaf blade D. petiole E. cells of the epidermis  **axillary thorn of hawthorn**	**Thorns** carry out protective function and are formed at lignification of apical or axillary buds, as are those of Hawthorn, Honey-Locust, etc. Also, spines may be reduced and indurated leaves; as in the barberry, where their nature is revealed by their situation, underneath an axillary bud. But prickles, such as those of Blackberry and Roses, are only excrescences of the bark, and not branches.
3.58. Among the investigated herabarium plants choose those which belong to the *Rosaceae* (Rose) Family … A. **Crategus sanguinea** B. Mellilotus officinalis C. Conium maculatum D. Capsella bursa-pastoris E. Polygonum persicaria	**The *Crataegus sanguinea* (hawthorn)** is a representative of Rosaceae Family. The hawthorn is a native to cultivate tree or a thorny shrubs with three-seven laciniate leaves and white flowers composed into complex corymbs. It has an edible red berry-like fruit, which actually is a pome.

3.59. In spring the tree of the *Rosaceae* Family (Rose) blossoms with white, fragrant flowers collected on the top of the shortened shoots in the drooping raceme. This is … A. **Padus racemose (cluster cherry)** B. Potentilla erecta (tormentil) C. Sorbus aucuparia (mountain ash) D. Malus domestica (apple) E. Crataegus sanguinea (redhaw)	***Padus racemose* (cluster cherry)**
3.60. Which representative of the Rosaseae family has spring bloom in form of white, fragrant flowers gathered in pendulous racemes at the ends of short shoots? **A. Padus rasemosa (P.avia)** B. Potentilla erecta C. Sorbus aucuparia D. Cerasus vulgaris E. Crataegus sanquinea	
3.61. The fruits of chokeberry Aronia are false, formed from the inferior, five-nesting ovaries and overgrown juicy hypanthium. Nests with one seed; separated by cartilaginous walls. The fruit is a ... A **pome** B syncarpous drupe C juicy follicle D fraga E pseudomonocarpous drupe	**Aronia chokeberry - Aronia melanocarpa**, subfamily - Maloideae, Rose family - Rosaceae, fruits is dark-blue pomes. Seed nests are separated by cartilaginous endocarp coriaceous walls. Pistil and overgrown hypanthium participate in formation of pomes.

The Heath Family

3.62. It is determined that one of the common features for *Vaccinium vitis-idaea* (foxberry) and Vaccinium myrtillus (bilberry) is that their type of the fruit is … A. berry B. fruitcase C. follicle D. drupe E. cremocarp	The **berry** is a fleshy fruit produced from a superior or inferior ovary. The receptacle and other part of the flower become a party in the fruit.
3.63. Studied leaves of the *Ericaceae* (Heath) Family are short-petiolar, oblong-linear with reflected down edges; from above – coriaceous, glabrous, brown and green; from below - red-haired and densely downy. These leaves are typical for … A. **Ledum palustre (marsh tea)** B. Arctostaphylos uva-ursi (bearberry) C. Vaccinium vitis-idaea (foxberry) D. Vaccinium myrtillus (bilberry) E. Oxycoccus palustris (wild cranberry)	***Ledum palustre* (marsh tea)** Habitat in Europe in the northern and central parts, and in Asia south to northern China, Korea and Japan. It grows in peaty soils, shrubby areas, moss and lichen tundra. The leaves are alternate, short-petiolar, skinny, and linear with declinate edges. The upper side of the leaf is dark-green and shining, but the lower side is red tomentose. Is poisonous plant.

3.64. Leaves of the representative the *Ericaceae* (Heath) Family are oblong, obovate, narrow at the base into a short petiole, from above it is dark-green, from below - lighter, without dark dotty glandules with well seen net of veins. This is … A. **Arctostaphylos uva-ursi (bearberry)** B. Vaccinium vitis-idaea (foxberry) C. Ledum palustre (marsh tea) D. Vaccinium oxycoccus (wild cranberry) E. Vaccinium myrtyllus (bilberry) 	***Arctostaphylos uva-ursi* (bearberry)**
3.65. Studied leaves of the *Ericaceae* (Heath) Family are alternate, short-petiolar, glabrous, elliptical with emarginated apex, with reflected down edges; from above – rifle-green; from below – with dark dotted glandules. These leaves are typical for … A. **Vaccinium vitis-idaea (foxberry)** B. Arctostaphylos uva-ursi (bearberry) C. Ledum palustre (marsh tea) D. Vaccinium oxycoccus (wild cranberry) E. Vaccinium myrtyllus (bilberry)	***Vaccinium vitis-idaea* (foxberry)**
3.66. While analysis of the vital form of *Arctostaphylos uva-ursi* (bearberry), *Vaccinium vitis ideae* (foxberry), *Vaccinium myrtillus* (bilberry) we determine that they are … A. **undershrubs** B. lianas C. herbs D. bushes E. subshrubs 	**Undershrub** – are wintering the above-ground shoots lignify only at the bottom and pass the winter, a top of the shoot is green, dies off yearly (e.g., *Ericaceae* Family). Is an evergreen subshrub up to 25 cm high *Dwarf subshrubs (or dwarf semishrubs)* are similar to under shrubs, but smaller (e.g., cranberry). *Subshrubs* (*or half-shrubs*) are the same with shrubs, but less size, up to 50 centimeters (e.g., *Ericaceae* Family)

3.67 It is determined that the leaves of evergreen plants studied are adapted to saving water: they are leathery, pubescent, scaly, wrinkled or flat with edges curved down. This is probably the species of the family ... A. **Ericaceae** B. Brassicaceae C. Papaveraceae D.Fabaceae E.Rosaceae 	Cranberries – Vaccinum vitis-idaea, bearberry - Arctostaphylos uva-ursi and others belong to the Heath Family - **Ericaceae**, and have following type of structure: low growing evergreen, creeping shrubs, dwarf shrubs with small coriaceous leaves, which have edges folded down.
3.68. We have collected black berries with glaucous bloom, roundish, flattened at the top, with a ring of small cloves cup, a pit in the center and a column. These are fruits of ... A. **bilberry** B. labrador tea marsh C. bearberry D. cranberry E. cowberry	**Berries** of bilberry (**Vaccinium myrtillus**) Ericaceae family are formed by lower ovary, they are dark blue, with a bluish waxy coating. Flattened at the apex, with a dimple, remains of the perianth, and sometimes those of stigma. 

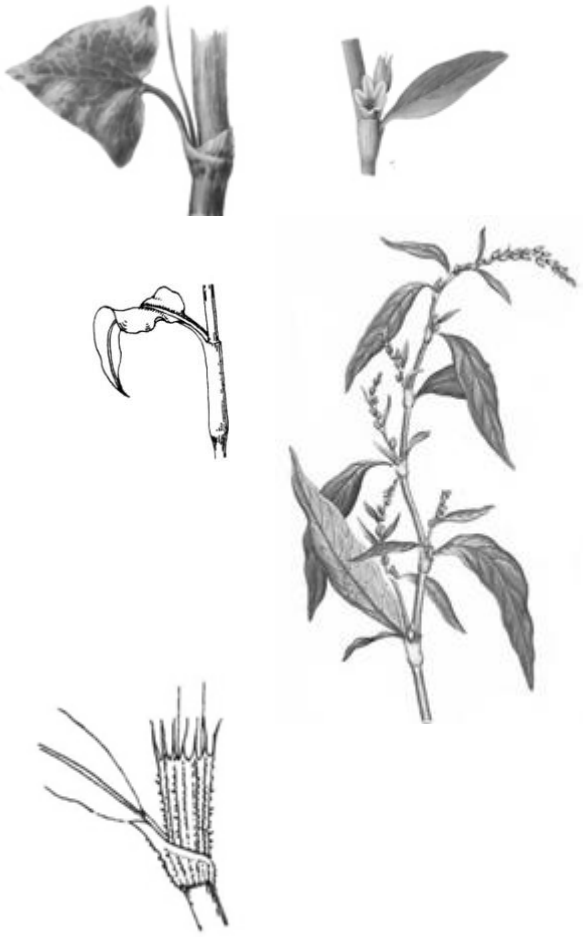
The Polygonaceae Family

3.69. The leaf investigated has a filmy ocrea that embraces the base of internode. The presence of such modified stipules is a diagnostical feature of the … Family

A. **Polygonaceae (the Knotweed) Family**
B. the Gramineae (Grass) Family
C. the Rosaceae (Rose) Family
D. the Fabaceae (Legume) Family
E. the Solanaceae (Potato or Nightshade) Family

The leaves of ***Polygonaceae*** are simple, and arranged alternately on the stems. Each leaf has a peculiar pair of fused, sheathing stipules known as an ocrea.

Leaf with ocrea:



3.70. While comparative analysis of the plant leaves of *Polygonaceae* (Knotweed) Family we find that their common feature is the presence of …

A. **ocrea**
B. vaginal
C. tendrils
D. spines
E. bracts

3.71. Cultivated food plant of the *Polygonaceae* (Knotweed) Family has a reddish stem and cordate-arrow-shaped leaves. The fruit is a triquetrous nut. This plant is …

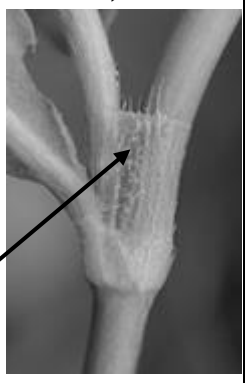
A. **Fagopirum saggitattum**
B. Polygonum bistorta
C. Polygonum hydropiper
D. Polygonum aviculare
E. Rumex confertus

***Fagopyrum sagittatum* (common buckwheat).**

The leaves structure of buckwheat differs from other species by brightness (shining), consistence (slightly fleshy), location (apical-sessile) and shape (cordate).

3.72. The medicinal plant of the *Polygonaceae* (Knotweed) Family is determined according to the typical features: stem is reddish, leaves are triangular and cordate, inflorescences are panicle of corymbs and flowers are pink, which are adapted for cross-pollination. This is…

A. **Fagopyrum sagitattum (common buckwheat)**
B. Polygonum bistorta (snake-root)
C. Polygonum aviculare (bird's knotgrass)
D. Rumex acetosa (garden sorrel)
E. Rumex confertus (horse sorrel)

3.73. Perennial herbal plant of the *Polygonaceae* (Knotweed) Family has thick, horizontal, serpentine rhizome and apical spicate inflorescence, which consists of small pink flowers. This is … A. **Polygonum bistorta (snake-root knotweed)** B. Polygonum persicaria (spotted knotweed) C. Polygonum hudropiper (water pepper) D. Polygonum aviculare (bird's knotgrass) E. Rumex acetosa (garden sorrel).	A ***Polygonum bistorta*** (snake-root knotweed) has a typically serpentine rhizome (bistorta – "twice wriggled")
3.74. The plant of *Polygonaceae* (Knotweed) Family has a dense, upright, spike-shaped inflorescence; its leaves are lanceolate with brown, U-shaped spot; red-brown, ciliated on the sides' ocreas. These features allow to suppose that this plant is … A. **Polygonum persicaria (spotted knotweed)** B. Polygonum aviculare (knot grass) C. Polygonum bistorta (snake-root) D. Rumex confertus (horse sorrel) E. Fagopyrum sagitatum (common buckwheat)  **ocrea**	P***oligonum persicaria*** **(spotted knotweed)**
3.75. The *Rumex acetosa* (garden sorrel) early in spring forms radial rosette of macropodous leaves; their leaf blade in its form is … A. **spear-shaped (or hastate)** B. cordate C. kidney-shaped D. diamond (or rhombus)-shaped E. falcated	***Rumex acetosa*** **(Garden sorrel)** Common sorrel has been cultivated for centuries. The leaves may be puréed in soups and sauces or added to salads; they have a flavour that is similar to kiwifruit or sour wild strawberries. The plant's sharp taste is due to oxalic acid, which is a poison. In small quantities sorrel is harmless; in large quantities it can be fatal.

The Apiaceae Family

3.76. The determined plant has fistular, costate stems, inflorescence is compound umbel, fruit is schizocarpous – cremocarp, which contains ether oils; which is typical for …

A. **the Apiaceae (Carrot) Family**
B. the Fabaceae (Legume) Family
C. the Ericaceae (Heath) Family
D. the Brassicaceae (Mustard) Family
E. the Asteraceae (Sunflower) Family

3.77. Investigated plant has edible root; ribbed-striated and fistular stems; leaves are repeatedly pinatisected, petiole with vagina; inflorescences is compound umbel; fruit – cremocarp with gum ducts in pericarp. Such features are typical for plants of the family …

A. **Apiaceae (Carrot)**
B. Solanaceae (Potato)
C. Fabaceae (Legume)
D. Brassicaceae (Mustard)
E. Scrophulariaceae (Figwort)

3.78. A plant under examination has storage root; its stems are ribbed and channeled, hollow; leaves are many times pinnatisected, compound umbel; frut is the cremocarp in the pericarp. Such characteristics are typical for the plants of the following family:

A. **Apiaceae**
B. Solanaceae
C. Scrofulariaceae
D. Brassicaceae
E. Fabaceae

3.79. Some of the investigated plants have fruits with common features. They explode into 2 mericarps, which have longitudinal costas with conductive bundles and intercostals scrobiculus with essential oil canaliculus. So, these plants belong to the family …

A. **Apiaceae (Carrot)**
B. Lamiaceae (Mint)
C. Papaveraceae (Poppy)
D. Solanaceae (Potato)
E. Rosaceae (Rose)

3.80. While studying the plants we determine common features of fruits. They fall into two parts, which have longitudinal ribs with conductive bundles and furrows with ether oil tubules. So, the plant belongs to the … Family

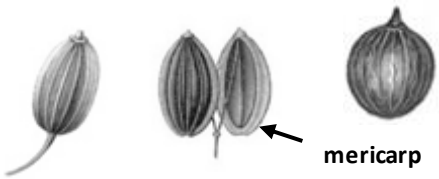
A. **the Apiaceae (Carrot) Family**
B. the Lamiaceae (Mint) Family
C. the Papaveraceae (Poppy) Family
D. the Solanaceae (Potato or Nightshade) Family
E. the Fabaceae (Legume) Family

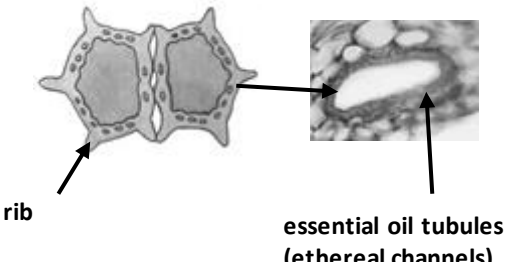
3.81. The analyzed plant has hollow ribbed stems, compound umbel inflorescence, schizocarpic fruit (cremocarp) and is rich in essential oils, which is a characteristic of:

A. Apiaceae
B. Fabaceae
C. Ericaceae
D. Brassisaceae
E. Asteraceae

Diagnostic features of the *Apiaceae* Family

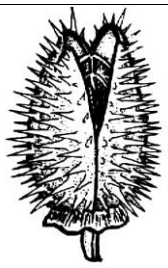
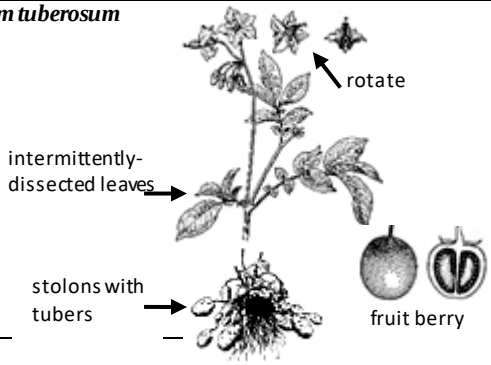
Cremocarp is a type of schizocarp, derived from two fused mericarps, that divides into two one-seeded units at maturity. It is typical of the *Apiaceae*





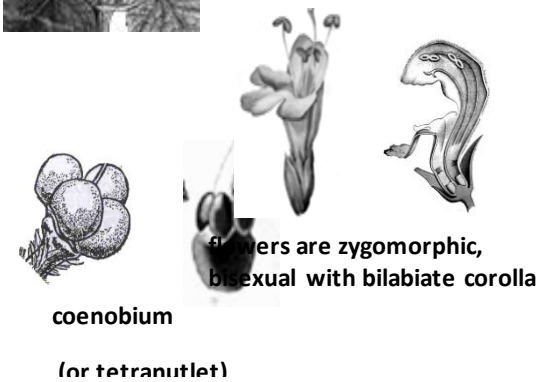
3.82. Select the type of a fruit by the following properties: a coenocarp fruit whose mericarps have 5 axial main edges between which secondary edges can be contained. A lot of ethereal oils are contained in the ethereal channels of its pericarp. A. **cremocarp** B. cypsela C. nut D. legume E. silique	
3.83. Plant of the *Apiaceae* (Carrot) Family has large thrice-pinnatisected leaves on the filamentous segments; inflorescences - compound umbels; yellow flowers and small oblong fruits – cremocarp. Fruits are used for preparation dill water. This is … A. **Foeniculum vulgare (fennel)** B. Anethum graveolens (dill) C. Carum carvi (caraway) D. Petroselinum crispum (parsley) E. Daucus sativus (species of carrot)	***Foeniculum vulgare* (fennel)** It is a highly aromatic and flavorful herb with culinary and medicinal uses, and, along with the similar-tasting anise, is one of the primary ingredients of absinthe.
3.84. This poisonous plant of the Apiaceae Family has red-violet points on the stem and obnoxious mouse odour. This is … A. **Conium maculatum** B. Anisum vulgare C. Apium graveolens D. Anethum graveolens E. Foeniculum vulgare	***Conium maculatum*** is poisonous plant.
3.85. Some medicinal plants can be poisonous. Choose such a plant of the Apiaceae (Carot) Family from the list below … A. **Cicuta virosa** B. Viburnum opulus C. Valeriana officinalis D. Plantago major E. Arctium lappa	***Cicuta virosa*** is poisonous plant.

The Solanaceae family

3.86. Among the representatives of the *Solanaceae* (Potato) Family studied the fruit berry is present in A. **Atropa belladonna (belladonna)** B. Hyoscyamus niger (poison tobacco) C. Datura stramonium (datura) D. Nicotiana tobacum (species of tobacco) E. Nicotiana rustica (rustic tobacco)	***Atropa belladonna* (belladonna)** representatives of the *Solanaceae (Potato) Family* has a black bright dithecal fruit berry in the accrescent calyx.
3.87. Bacca fruit is typical for the following representative of Solanaceae Family: A. **Atropa belladonna** B. Hyoscyamus niger C. Nicotiana tabacum D. Datura stramonium E. Datura innoxia	
3.88. While identification the Datura stramonium (datura) fruit we determine that it is … A. **septifragal capsule** B. bright black berry C. ascidiform capsule with lid D. flash globular cynarodium E. berry in orange calyx	 **Datura stramonium (datura)** fruit is septifragal capsule. Ovary – bilocular, devided by false septums, which do not rich the top, into four nests. Capsule – upright, thorned burst by valves.
3.89. The Family Solanaceae includes a pubescent plant, its leaves are alternate, pinnate, intermittently, irregularly dissected into larger and smaller segments, inflorescence is double bostryx, corolla is rotate, and fruit is a globular green poisonous berry, tubers with stolons. This is ... A. **Solanum tuberosum** B. Solanum dulcamara C. Solanum lycopersicum D. Capsicum annuum E. Hyoscyamus niger	***Solanum tuberosum*** 

The Lamiaceae Family

3.90. Adenotrichous odorous plant has tetrahendral stem, spicate inflorescences consisting of the false whorl, bilabiate corolla and fruit – tetranutlet, so it belongs to the … family. A. **Lamiaceae (Mint)** B. Scrophulariaceae (Figwort) C. Brassicaceae (Mustard) D. Apiaceae (Carrot) E. Solanaceae (Potato)	**Diagnostic features of the *Lamiaceae* (Mint) Family** **Stems are square in cross-section (tetraquetrous).** **forms of the leaf arrangement – crosswise opposite**
3.91. Select the family of the described officinal plant: "Perennial herbaceous plant with an ascending tetrahedral stem, opposite leaf aestivation and entire leafs. Flowers are zygomorphic, bisexual with bilabiate corolla and are united into semi-rings in leaf axils. The fruit is coenobium." A. **Lamiaceae** B. Asteraceae C. Poaceae	

D. Brassicaceae E. Rosaceae	
3.92. An essential oil plant under examination has a tetraquetrous stem, flowers with bilabiate corolla, coenobium fruit. These characteristics are typical for the following family: A. **Lamiaceae** B. Papaveraceae C. Scrophulariaceae D. Polygonaceae E. Solanaceae	
3.93. The determined essential oil plant has tetraquetrous stem, flowers with bilabiate corolla, fruit is coenobium; which is typical for … A. **the Lamiaceae (Mint) Family** B. the Papaveraceae (Poppy) Family C. the Polygonaceae (Knotweed) Family D. the Potato or Nightshade (Solanaceae) Family E. the Figwort (Scrophulariaceae) Family	
3.94. In the plant cultivation farming there cultivated officinal ether oil plants, which do not grow naturally in Ukraine, namely: *Mentha piperita* (peppermint), *Ortosiphon stamineus* (St. John's wort) and … A. **Salvia officinalis (garden sage)** B. Origanum vulgare (common origanum) C. Leonurus cardiaca (motherwort) D. Thymus serpyllum (wild thyme) E. Melissa officinalis (lemon balm)	***Salvia officinalis*** Homeland – Mediterranean and Minor Asia. Cultivated – India, Syria, Canada, USA, countries of Europe, Ukraine, Crimea
3.95. With the purpose of preservation sort quality we choose optimal way of the *Mentha piperita* (peppermint) reproduction: by means of … A. **parts of rhizome** B. parts of tuber C. cutting of the leaves D. seeds E. reproductive buds	

3.96. Folk medicine uses flowers of white deadly nettle (*Lamium album*) to cure diseases of spleen, catarrh and others. What a family this plant belongs to? A. **Lamiaceae (mint)** B. Ranunculaceae (buttercup) C. Solanaceae (potato) D. Asteraceae (aster) E. Fabaceae (legume)	***Lamium album* (White deadly nettle)** **The *Lamiaceae* (Mint) Family.**
3.97. Species characters of the *Thymus serpyllum* are: the existence of apical cephalanthium, dark dotted glandules on the under side of a leaf, long fuzzes along the edge of a base and furthermore: A. **decumbent** shoot B. thorn shoot C. shoot with spine D. climbing shoot E. shortened recumbent shoot	***Thymus serpyllum*** (Creeping thyme or wild thyme)
3.98. 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	***Leonurus cardiaca* (Motherwort)**
3.99. Choose the species of a plant whose apical shoots are used in medicine practice for obtaining of debilitants: A. **Leonurus cardiaca** B. Glycyrrhiza glabra C. Digitalis purpurea D. Ledum palustre E. Fagopyrum sagittatum	Use in cardiostimulative therapy.

The Scrophulariaceae Family

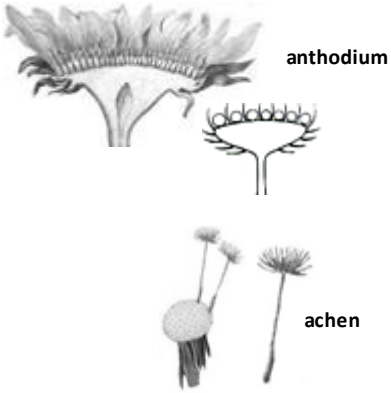
3.100. Medical plants of Digitalis genus contain cardiac glycosides and are used as a raw material for cardiovascular insufficiency drugs. They belong to the Family ... A. **Scrophulariaceae** B. Lamiaceae C. Apiaceae	Plants of ***Scrophulariaceae*** family accumulate cardiac glycosides, which are used for therapy of cardiac decompensation.

D. Solanaceae E. Polygonaceae **3.101.**The figwort family Scrophulariaceae includes a biennial plant up to 1,5 m high, with golden-yellow flowers gathered in spiked inflorescences. The flowers have five stamens. Specify this plant: **A. Verbascum flomoides** B. Digitalis purpurea C. Digitalis grandiflora D. Digitalis lanata E. Digitalis Ferruginea	

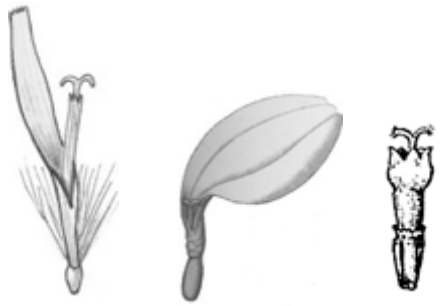
The Ranunculaceae Family

3.102. A perennial herb plant of the *Ranunculaceae* Family has repeatedly pinnatisected leaves; apical, large, actinomorphous yellow flowers. This is … A. **Adonis vernalis (spring vernalis)** B. Aconitum napellus (aconite) C. Brassica nigra (black mustard) D. Rosa canina (dog rose) E. Daucus carota (species of carrot)	***Adonis vernalis* (Spring vernalis)**
3.103. During identification of a perennial herb of Ranunculaceae family it was found to have: apical flowers of regular form up to 6 cm in diameter; 5 downy violetand-green calyx lobes of irregular serrate form; up to 20 bright yellow glossy petals without nectarostigma. What plant is it? **A. Adonis vernalis** B. Helleborus purpurascens C. Ranunculus acris D. Delphinium elatum E. Aconitum napellus	

The Asteraceae Family

3.104. What is the family which can have flowers with different shapes of corolla (ligulate, false- ligulate, tubular) in one inflorescence? A. **Asteraceae** B. Lamiaceae C. Solanaceae D. Fabaceae E. Magnoliaceae	

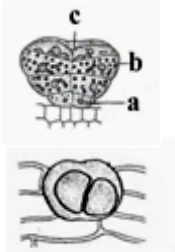
3.105. In antodiums of sunflower (*Asteraceae*) representatives we determined all stated types the flowers except …
A. **bilabiate**
B. tubular
C. ligulate
D. false-ligulate
E. thimble (funnelform)



ligulate flower **false- ligulate flower** **tubular flower**

3.106. The plant has ether oil glandule, its fruit is achen and its inflorescence is anthodium. This is the diagnostic features of the family…
A. **Asteraceae**
B. Scrophulariaceae
C. Solanaceae
D. Lamiaceae
E. Rosaceae

ether oil glandule



3.107 A perennial plant of the *Asteraceae* family has large, single and apical anthodiums with purple false-ligulate flowers. It is used to strengthen the immunity. This is …
A. **Echinacea purpurea (purple cone-flower)**
B. Achillea millefolium (common yarrow)
C. Chamomilla recutita (common camomile)
D. Artemisia absinthium (common wormwood)
E. Taraxacum officinale (dandelion)

drugs to immunity increase

Echinacea purpurea
***Asteraceae* Family**

3.108. The herb plant investigated has articulate lacticifers with anastomoses, which contain a white latex, which is typical for …
A. **Taraxacum officinale (dandelion)**
B. Ranunculus acris (species of buttercup)
C. Adonis vernalis (spring vernalis)
D. Papaver somniferum (opium poppy)
E. Aconitum napellus (aconite)

3.109. While studying the samples of medicinal plants we determine that belongs to… *Asteraceae* Family.
A. **Taraxacum officinale (dandelion)**
B. Atropa belladonna (belladonna)
C. Quercus robur (english oak)
D. Urtica dioica (great nettle)
E. Vinca minor (common periwinkle)

3.110. While microscopical study of underground plant organs of the *Asteraceae* (Aster) Family we found out articulate lacticifers with anastomosis, which are filled with white latex. This is typical for

***Taraxacum officinale* (dandelion)**
***Asteraceae* family**

A. **Taraxacum officinale**
B. Helianthus annuus
C. Artemisia absinthium
D. Bidens tripartite
E. Achillea millefolium

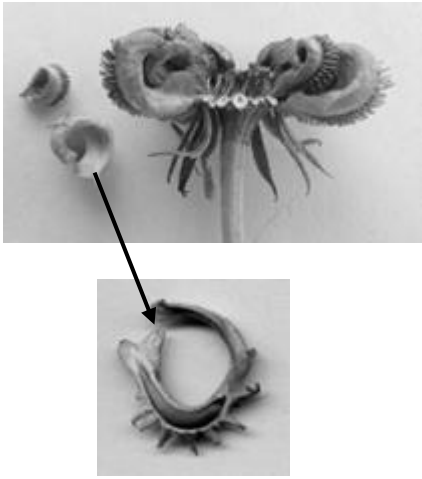
3.111. What a medical plant of *Asteraceae* Family has all yellow ligulate and bisexual flowers which form anthodium?
A. **Taraxacum officinale**
B. Bidens tripartite
C. Tussilago farfara
D. Tanacetum vulgare
E. Arnica Montana

3.112. *Calendula officinalis* (pot marigold) has inflorescences, which is called …
A. **anthodium**
B. head
C. raceme
D. spadix
E. corymb

3.113. Calendula officinalis which a representative of the aster family is characterized by the following inflorescence type:
A. flowerhead
B. umbel
C. catkin
D. glome
E. cyme

3.114. *Calendula officinalis* (cypselas of marigold) are falciform and hamiform with narrow beak, the surface is …
A. **prickly**
B. glabrate
C. softy hairy
D. felt hairy
E. bristled

***Calendula officinalis* (pot marigold)**



3.115. The annual inshore plant of *Asteraceae* (Sunflower) Family has tripartite leaves, terminal

***Bidens tripartita* (bur-marigold)**

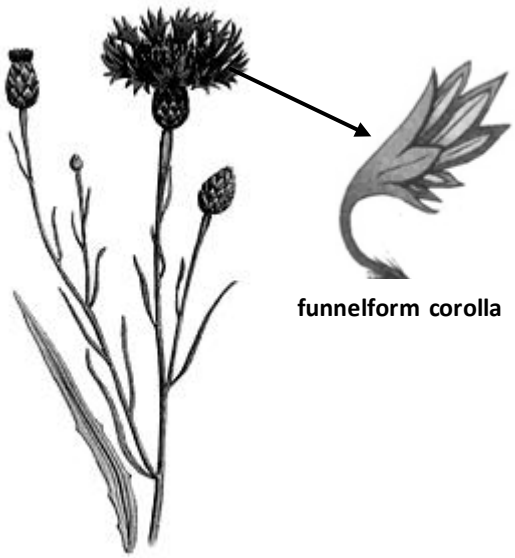
anthodiums with tubular flowers, flat seeds, tenent due to the presence of 2-3 hirsute teeth. This is …

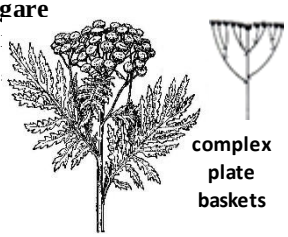
A. **Bidens tripartita (bur-marigold)**
B. Chamomilla recutita (chamomile)
C. Centaurea cyanus (blue cornflower)
D. Echinacea purpurea (purple cone-flower)
E. Artemisia vulgaris (mugwort)

3.116. At the practice of procurement of *Compositae* plants the notion of "flower" may have both meaning: a single flower as well as an inflorescence. However in botanics the notion of "flower" is correct for…

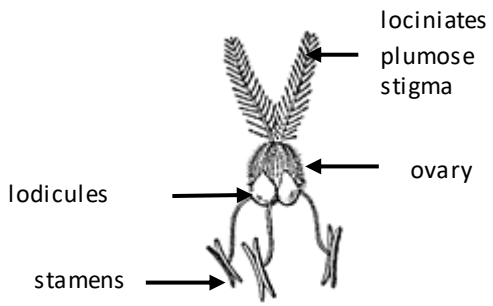
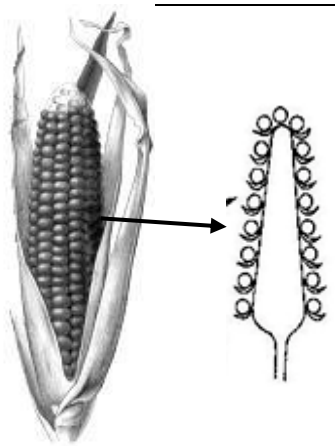
A. **Centaurea cyanus**
B. Gnaphalium uliginosum
C. Arnica montana
D. Echinops ritro
E. Bidens tripartita

Centaurea cyanus



3.117. In rosette of Tussilago farfara, the leaves are macropodous, broadly ovate-cordate. The upper side of the plate is green, and the lower one is ... A. **whitish, densely pubescent** B. is bright green, slightly pubescent C. dark green, no pubescence D. dark green, glandular-pubescent E. glossy, with thick cuticle	One of the diagnostic features of **Tussilago farfara** (coltsfoot vulgare) is the one of its leaf blade - its upper side is green, and the lower one is white dense (felted) pubescent
3.118. Apical shoots of Tanacetum vulgare have been collected as medicinal raw material, they are heterogeneous monopodial inflorescence: complex... A. **corymb of anthodiums** B. corymb of bostryx C. dichasium ears D. umbrella of heads E. panicle of heads	Inflorescence **Tanacetum vulgare** (tansy) is complex, monopod (botrioidnoe), heterogeneous growing monopodially, corymbose branches and has small elementary inflorescences: anthodiums. 
3.119. In Carpathian mountain meadows one can find herbs with orange anthodiums, upright stem and basal rosette of leaves. This is... A. **Arnica montana** B. Cychorium intybus C. Calendula officinalis D. Echinacea purpurea E. Centaurea cyanus 	The **Arnica (Arnica montana**) is an endemic, which grows in the Carpathian Mountains in a relatively limited area. The species is listed in the Red Book of Ukraine. It belongs to the Asteraceae family, which is indicated by presence of basal leaf rosette and inflorescence anthodiums.
The Alliaceae Family	
3.120. The comparison representatives of different families shows that umbel-like inflorescence with spathe, simple perianth, fruit - fruitcase and underground organ - bulb are typical for the species of the … family. A. **Alliaceae (Onion)** B. Rosaceae (Rose) C. Fabaceae (Legume) D. Brassicaceae (Mustard) E. Solanaceae (Potato)	***Allium cepa* (common onion)**
3.121. The bulbous plant analyzed has a specific odour, radical cylindrical leaves, utricular flower stalk, bearing simple umbel with filmy spathe, and its fruit is fruitcase. These features indicate that it is … A. **Allium cepa (common onion)** B. Allium sativum (garlic) C. Convallaria majalis (lily-of-the-valley) D. Agropyrum repens (couch-grass) E. Acorus calamus (sweet flag)	

The Gramineae Family

3.122. In the flowers prepared a perianth is reduced to 2 films, 3 stamens are on the long stamen filaments, pistil is with 2-lociniates plumose stigma, which is typical for the … Family. A. **the Gramineae (Grass) Family** B. the Fabaceae (Legume) Family C. the Convallariaceae (Lily-of-the-valley) Family D. the Alliaceae (Onion) Family E. the Asteraceae (Sunflower) Family	
3.123. While studying under the magnifying glass the flowers of *Zea mays* (maize) gathered in inflorescence spadix it is determined that flowers are … A. **female** B. mail C. bisexual D. asexual E. achlamydeous	
3.124. The perennial weed from *Gramineae* (Grass) Family occus often, its rhizome is a medicinal agent that normalizes metabolism and diuresis. This is … A. **Agropyron repens (couch-grass)** B. Triticum aestivum (soft wheat) C. Zea mays (maize or corn) D. Avena sativa (oats) E. Oryza sativa (rice)	***Agropyron repens* (couch-grass)**

Medicinal plants of different families

3.125. The plant of the *Rhamnaceae* Family has an alternating leaf position and has no thorns. Its venation is pinnate with 6-8 pair straight lateral veins. This is … A. **Frangula alnus** B. Rhamnus cathartica C. Padus racemosa D. Aronia melanocarpa E. Sambucus nigrum	***Rhamnaceae* Family** ***Frangula alnus***

3.126. The leaves of *Rhamnus cathartica* (buckthorn) are ovate, venation is pinnate, 3-4 pairs of lateral veins, they are arcuate and come together at the top of the leaf, the margin of the leaf blade is …

A. **small-crenate**
B. entire
C. large-daedalous
D. serrate
E. ciliated

***Rhamnaceae* Family**
***Rhamnus cathartica* (buckthorn)**

3.127 Black, flesh fruits with 3 or 4 stones have the laxative effect, they are gathered from diecious, thorny bush with opposite branching. This plant is …

A. **Rhamnus cathartica (common buckthorn)**
B. Aronia mellanocarpa (black chokeberry)
C. Frangula alnus (black dogwood)
D. Sambucus nigra (european elder)
E. Viburnum opulus (european dogwood)

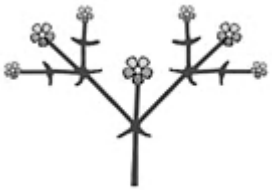
3.128. The perennial plant of the *Malvaceae* (Mallow) Family is used as an expectorant. Leaves are simple, 3-5-palmatilobate; flowers are large, pink, axillary and aggregated in racemose inflorescences. The fruit is cremocarp. This is …

A. **Althaea officinalis (marsh mallow)**
B. Fragaria vesca (wild strawberry)
C. Potentilla erecta (tormentil)
D. Tussilago farfara (colt's foot)
E. Thymus serpyllum (wild thyme)

***Malvaceae* (mallow) Family**
***Althaea officinalis* (marsh mallow)**

3.129. *Valeriana officinalis* (common valerian) has well developed main axes of the inflorescence, from which the axis of next orders with dichasiums situated at the same level grows. This is …

A. **corymbose panicle of the dichasiums**
B. simple corymb of the dichasiums
C. compound corymb of the dichasiums
D. compound spike of the dichasiums
E. compound umbel of the dichasiums



dichasium

***Valeriana officinalis* (common valerian)**

3.130. The plant investigated is a tree with opposite palmately compound leaves, without stipules. Flowers are collected in upright pyramidal thyrsi - panicle of the

bostryxes. Fruit is a spicular roundish fruitcase with one seed. These features are typical for …

A. **Aesculus hippocastanum (horse chestnut)**
B. Rhamnus cathartica (common buckthorn)
C. Quercus robur (english oak)
D. Hippophae rhamnoides (sea buckthorn)
E. Apium graveolens (celery)

***Aesculus hippocastanum* (horse chestnut)**

3.131. The fruit, globular fruitcase with thorns, is examined. It opens with three valves, contains one large, dark-brown, bright seed with a light lusterless spot. This fruit belongs to …

A. **Aesculus hippocastanum (horse-chestnut)**
B. Papaver somniferum (opium poppy)
C. Datura stramonium (devil's-trumpet)
D. Plantago major (common plantain)
E. Hipericum perforatum (common St. John's wort)

3.132. Fruit of the *Tilia cordata* (small-leaved lime) is pseudomonocarpous with firm skinny pericarp and 1 or 2 seeds. This is …

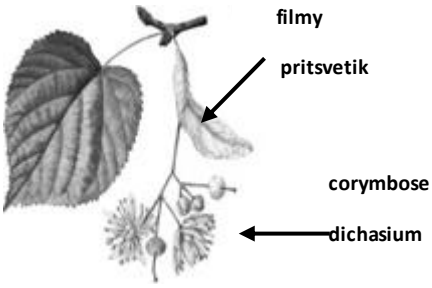
A. **nutlet**
B. silicle
C. achene
D. silique
E. fruitcase

***Tilia cordata* (small-leaved lime)**

3.133. For diaphoretic herbal mix we have collected 3-5-flower, corymbose dichasia with light yellow, elongated wing-shaped, membranous bracts, which grows together with the axis until the middle of the inflorescence. The flowers are fragrant and are yellow in color. This inflorescence belongs to...

A. **Tilia cordata**
B. Viburnum opulus
C. Robinia pseudoacacia
D. Mentha piperita
E. Padus avium

Tilia cordata is a small-leaved lime.
Medicinal raw material is dichasia inflorescence with yellow bracts.

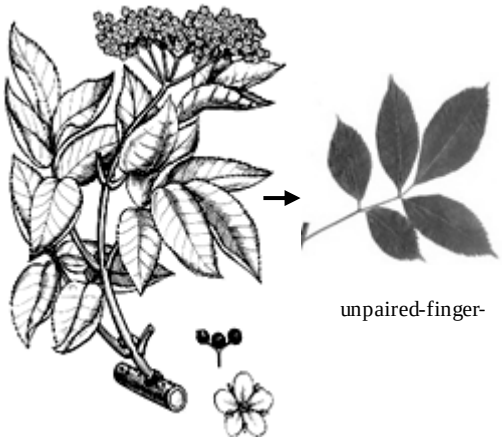


3.134. Diaphoretic herbal tea includes dichasial cymes with light-yellow, oblong, wing-like, squamelliferous perianth. The flowers are fragrant, yellowish. These inflorescences belong to: **A. Tilia cordata** B. Viburnum opulus C. Robinia pseudoacacia D. Mentha piperita E. Padus avium	
3.135. Among the plants of deciduous forest ambisexual tall trees prevail. They are covered with a thick dark-grey bark with deep cracks. The leaves are short petiolar, pinnatelylobate, pubescent from below. Fruits are acorn with spinelet on the top. So, this plant is … A. **Quercus robur (english oak)** B. Robinia pseudoacacia (black locust) C. Aesculus hippocastanum(horse chestnut) D. Tilla cordata (small-leaved lime) E. Betula verrucosa (common birch) 	***Quercus robur* (english oak)**
3.136. During determination of fruit type *Hypericum perforatum* it was found that: the fruit is coebocarpous, dry, opens with valves and contains a big number of seeds. Therefore the fruit of Hypericum perforatum is: A. **fruitcase** B. multifollicle C. agrigate achene D. follicle E. coenobium	 **Hipericum perforatum (common St. John's wort)**
3.137. While ascertainment the type of *Hipericum perforatum* (common St. John's wort) fruit it is indicated that the fruit is cenocarpous, dry, opens by the seams and contains large quantity of seeds. So, this fruit is a … A. **fruitcase** B. polyfollicle C. follicle D. coenobium E. polynutlet	

3.138. The plant belongs to *Berbereceae* Family. This is … A. **Podophyllum peltatum** B. Adonis vernalis C. Chelidonium majus D. Saponaria officinalis E. Hypericum perforatum 	***Berbereceae* Family** ***Podophyllum peltatum* (mayapple)** is a herbaceous perennial plant. Mayapple contains podophyllotoxin, which is used as a cytostatic and topically in the treatment of viral and genital warts.
3.139. Yellow-orange oblong pseudomonocarp drupes rich in vitamins and fatty oil are gathered from a female dioecious thorn bush – A. **Hippophaë rhamnoides** B. Rhamnus cathartica C. Amygdalus communis D. Sambucus nigra E. Prunus spinosa	***Elaeagnaceae* Family** ***Hippophae rhamnoides*** **(common sea-buckthorn)**
3.140. This marsh plant has ensiform leaves, inflorescence spadix with a veil, thick rhizome, light, fragrance, pink on the fracture, with well-defined and rapprochement scars and adventitious roots. This is ... A. **Acorus calamus** B. Ledum palustre C. Bidens tripartita E. Sanguisorba officinalis D. Valerina officinalis	**Acorus calamus (calamus swamp)** is a perennial hydrophyte of monocot class, Family Araceae. Rhizomes are rich with essential oils, tannins, flavonoids and other biologically active substances

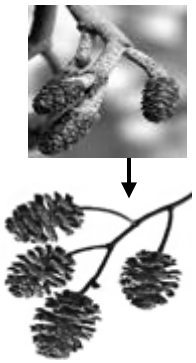
3.141. Petiolate, imparipinnately compound leaves have...
A. **Sambucus nigra**
B. Chelidonium majus
C. Vinca minor
D. Rumex confertus
E. Aesculus hippocastanum

Sambucus nigra (black elderberry) is a shrub with petiolate, imparipinnately compound leaves.



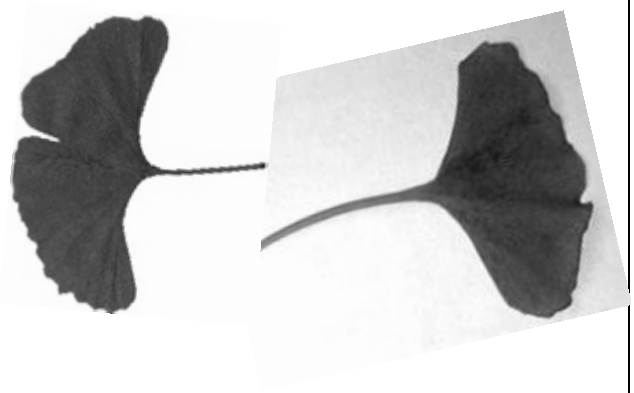
3.142. In gastric herbal mix there are oval brown lignified "cones" up to 1.5 cm long, which are ...
A. **seedheads alder**
B. larch cones
C. cypress cones
D. juniper cones
E. cones of hops

The alder`s female are small flowers collected in short oval aments with bracts that after fertilization of the flower and maturing of fruits nuts overgrow, lignifies and blossoms turn into brown pineal compound fruits.



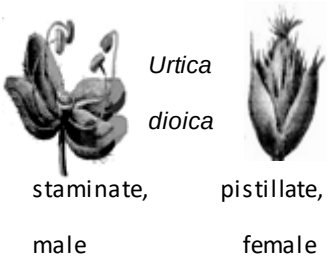
3.143. … has leaves with long petioles, leathery, fan-like entire plate or the one with a few notches at the top and with dichotomic venation.
A. **Ginkgo biloba**
B. Cedrus libani
C. Juniperus communis
D. Picea abies
E. Abies sibirica

Ginkgo biloba is relict species of Ginkgopsida class of gymnosperms. The main features include a flattened leaf with dichotomic venation.

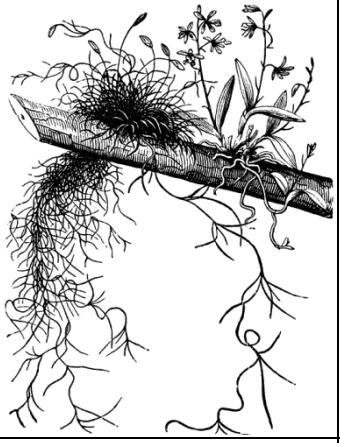


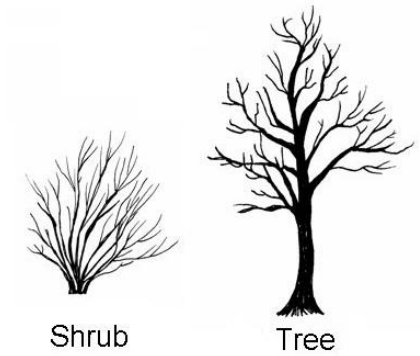
3.144 . It is known that leaves of most gymnosperm species are represented by needles. Which one of the species listed below has macropodous leathery leaves with solid flabellate lamina, dichotomous venation and one or several notches along the upper margin?

A. Ginkgo biloba
B. Cedrus libani
C. Juniperus communis
D. Picea abies
E. Abies sibirica

3.145. A dioecious plant, *Urtica dioica*, has staminate and pistillate flowers with a greenish plain perianth. Therefore, the flowers are ... A. **calyciform, unisexual** B. calyciform, bisexual C. coroliform, unisexual D. corolliform, bisexual E. doubleperianth, unisexual	Flowers that have only stamens or only pistils are **unisexual.** Plain filmy or green perianth is considered to be simple, **calyciform.** 

Content module 4.
ECOLOGY

4.1. Lichens are not present on the trees, growing in town, because of the … A. **chemical pollution in the environment** B. lack of the water C. deficiency of nutrients in soil D. excess of the moisture E. deficiency of the light 	**Lichens** are composite organisms consisting of a symbiotic organism composed of a fungus (the **mycobiont**) with a photosynthetic partner (the **photobiont** or **phycobiont**). Lichens occur in some of the most extreme environments on Earth - arctic tundra, hot deserts, rocky coasts, and toxic slag heaps. **Lichens** are sensitive to cleanliness of air, therefore they do not grow in chemically polluted environment.
4.2. Plants, settling on the trees, have aerial roots, feed individually (photosynthesize). So there are … A. **epiphytes** B. parasites C. semiparasites D. ephemers E. succulents 	**Epiphytes** are live on other plants, eat by absorption water and substances from environment all body (mosses, lichens) or by means of air roots (the higher plants). An **epiphyte** (or *air plant*) is a plant that grows upon another plant (such as a tree) non-parasitically, derives its moisture and nutrients from the air and rain
4.3. Plant grows in dry place, so is … A. **xerophyte** B. hygrophyte C. mesophyte D. hydrophyte E. epiphyte	A **xerophyte** or **xerophytic organism** (*xero* meaning dry, *phyte* meaning plant) is a plant which is able to survive in an environment with little available water or moisture, such as a desert. Xerophytic plants may have adaptations of their shape and form (morphology) or physiology that reduce their water loss or store water during periods of dryness.

4.4. Plants, which grow in conditions of middle moisture, belong to such ecological group as … A. **mesophyte** B. hydrophyte C. hygrophyte D. xerophytes E. succulent 	**Mesophytes** are terrestrial plants which are adapted to neither a particularly dry nor particularly wet environment. An example of a mesophytic habitat would be a rural temperate meadow, which might contain Goldenrod, Clover, Oxeye Daisy, and *Rosa multiflora*. Mesophytes make up the largest ecological group of terrestrial plants, and usually grow under moderate to hot and humid climatic regions.
4.5. Herb plant is dipped into water, so this plant is … A. **hydrophyte** B. hygrophyte C. mesophyte D. xerophytes E. epiphyte 	**Hydrophytes** are the plants, which grow in impoundments (e.g., lotus, cow lily, duckweed and sagittaria). The underwater parts of the plants differ from abovewater ones anatomically and morphologically. The root carries out the anchoring function in the substrate.
4.7. Perennial plant with hight of 5 m has some lignified stems, which branch near the soil. This is … A. **bush** B. tree C. liana D. subshrub E. herb 	**Shrubs (or bushes)** are perennial plants up to 5 m height, all above-ground shoots are lignified, almost of identical size, locate and branch very low from the ground (e.g., raspberry, dog rose). 
4.8. One of these medicinal plants belongs to weeds. Which one: A. **Plantago major** B. Papaver somniferum C. Mentha piperita D. Convallaria majalis E. Salvia officinalis	A weed is herbaceous plant not valued for use or beauty, growing wild and rank, and regarded as cumbering the ground or hindering the growth of superior vegetation... Applied to a shrub or tree, especially to a large tree, on account of its abundance in a district... An unprofitable, troublesome, or noxious growth.

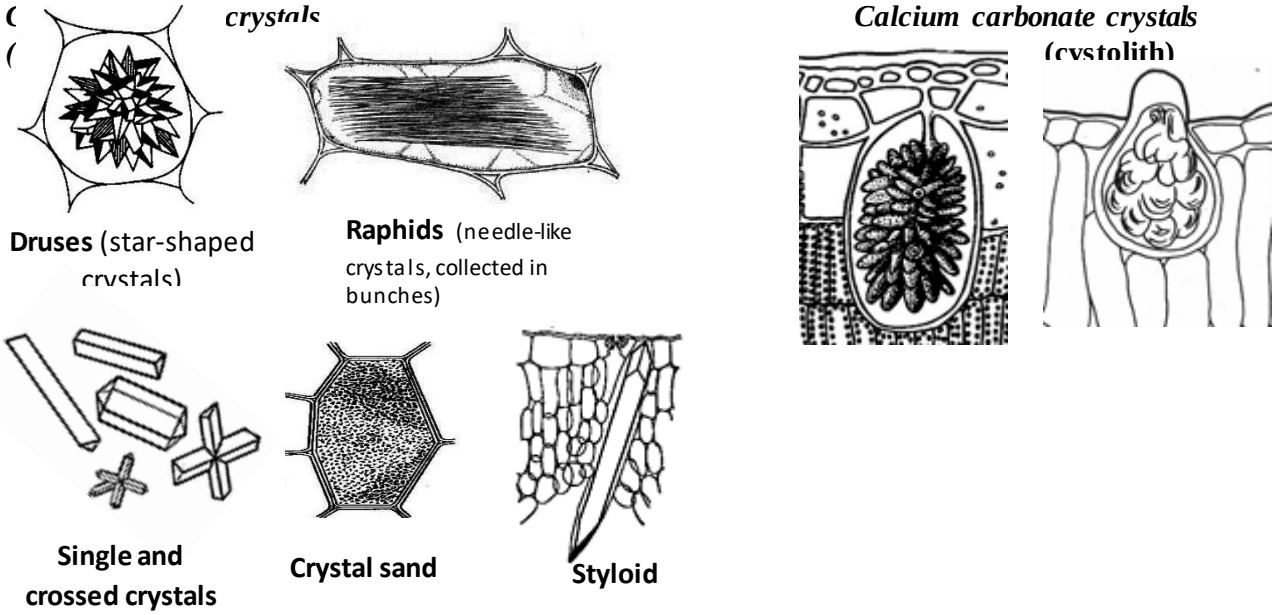
4.9. Many people develop allergic reactions during flowering of a quarantine weed, such as... A.**Ambrosia artemisiifolia** B. Equisetum arvense C. Stellaria media D. Erigeron Canadensis E. Convolvulus arvensis	(**Ambrósia artemisiifólia)** family Asteraceae is a dangerous cosmopolitan weed that causes allergic sinusitis, rhinitis and skin rashes during flowering.
4.10. Herbs that are submerged into water belong to ... A. **hydrophytes** B. hygrophytes C. mesophytes D. xerophytes E. skiophites	**Hydrophytes** are plants that are wholly or partially immersed in water (lotus, water lily, arrowhead, duckweed).
4.11. Vegetations of wetland and poor soils are investigated; they are dominated by herbaceous and grassy moss plants. This is a hallmark for vegetation of ... A. **marsh** B. forest C. meadow D. steppe E. ruderal	A bog is a wetland piece of land with coastal plants, helophytes. Their roots and stem bases are located in the ground under water, whereas stalks and flowers is over water.
4.12. Lily-of-the-valley and ... belong to early-flowering of rhizomatous ephemeroids A. **Adonis vernalis** B. Carum carvi C. Állium cepa D. Chamomilla recutita E. Thymus serpyllum	**Ephemeroids** are plants with a short 20-30-day cycle of vegetation. They bare dry period in the form of bulbs and rhizomes, and their above-ground part dies. Adonis vernalis - adonis spring belongs to these plants.
4.13. A plant which grows on the soil with abundant moisture and lack of oxygen has well developed aerenchyma and ... A. **pneumatophores roots** B. bulbs C. hapteron roots D. contractile roots E. buttres roots 	**Breathing roots (pneumatophores)** of tropical trees growing in marshy, silty places are going up in the air (negative geotropism) outgrowths with aerenchyma, allowing air to reach the underground roots.

Appendices

Appendix 1

Crystalline inclusion of plant cells

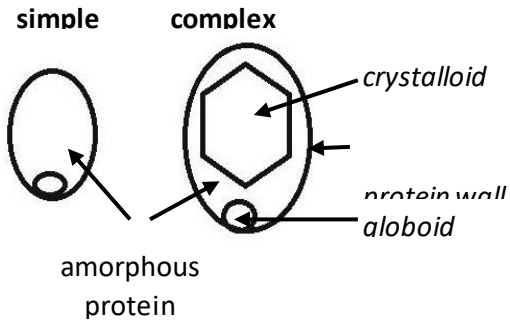
Crystalline hydrates



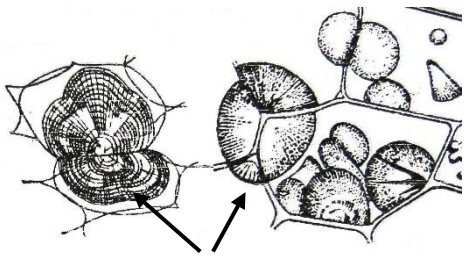
Appendix 2

Storage inclusion of plant cells

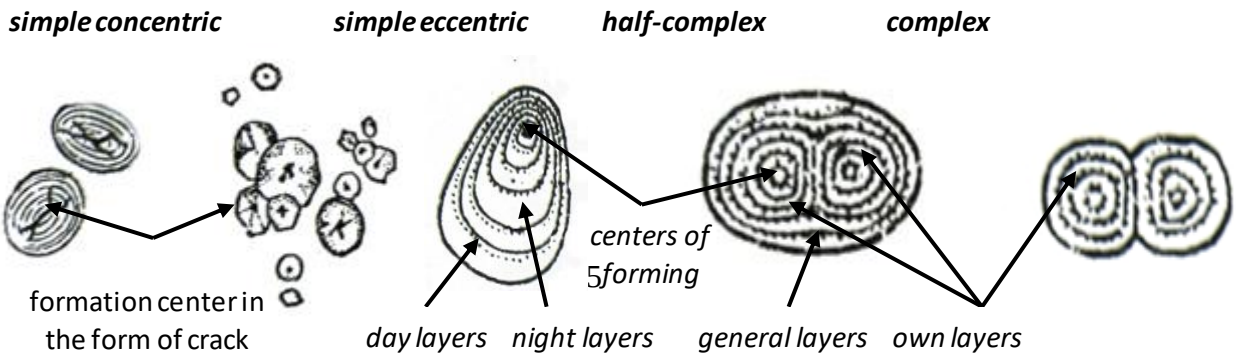
Aleuronic grains



Soluble polysaccharide - inulin



Starch grains



Appendix 3

Histochemical reactions to spare the inclusion of plant cells

Spare inclusion	Reagent	Result of reaction
Proteins (aleuronic grains)	Lugol's reagent	yellow coloration
	concentrated nitric acid	yellow coloration
Fats (fatty oils)	Sudan III	orange coloration
Starch (starch grains)	Lugol's reagent	blue-violet coloration
Inulin	70-96% ethanol	fall out spherocrystal consisting of thin needles

Appendix 4

Histochemical reactions to some components of the secondary cell wall

Substances, which produce of secondary changes	Name of secondary changes	Reagent	Result of reaction
cellulose	-	zinc chloride iodine	violet coloration
		Lugol's reagent	yellowish-brown coloring
		magenta sour	red coloration
lignin	lignification	phloroglucine with conc. HCl	red coloration
		aniline sulfate	lemon yellow coloration
		safranine	red coloration
		chlor zinc iodine with H_2SO_4	yellow coloring
suberin	suberization	Sudan III	pink-orange coloring
		concentrated solution KOH	yellow coloring and swelling
cutin	cutinization	Sudan III	pink-orange coloring
		chlor zinc iodine	yellow coloring
mucus	intramolecular changes	Indian ink	white mucous cells on a dark background
		methylene blue	blue mucosal cells in the white-blue background
mineral substances	mineralization	burning	residue of silicon skeleton after burning
		phenol	pink coloring

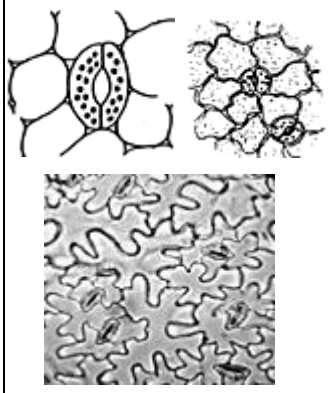
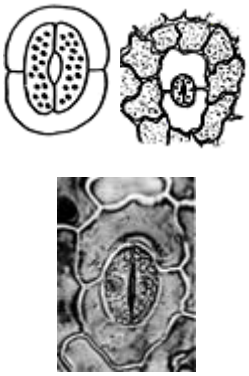
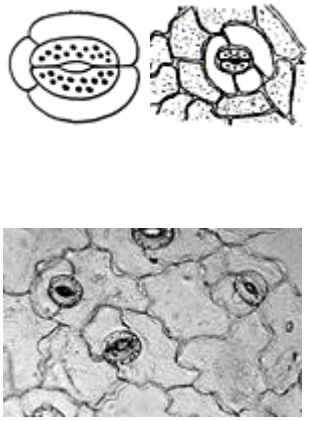
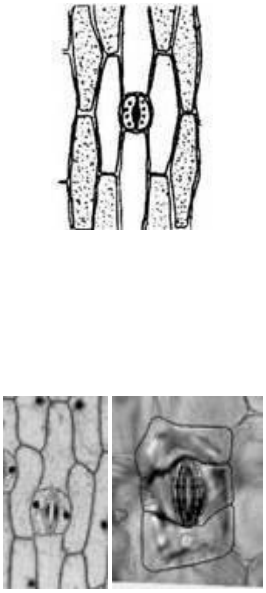
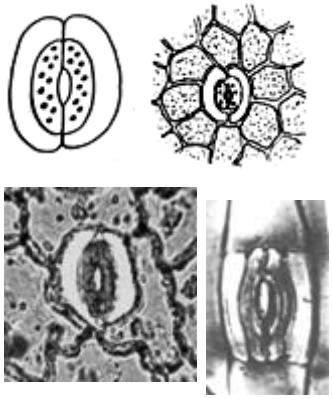
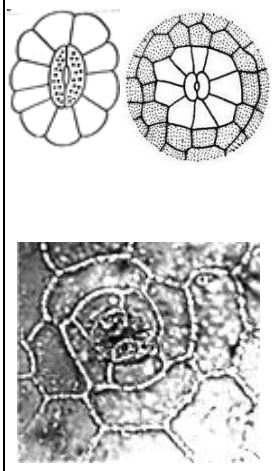
Appendix 5

Classification of plant tissues

Meristematic (meristems)	primary	apical intercalary (or intermediate) lateral: - procambium (forming the primary phloem and xylem) - pericycle (forming the lateral roots, primary chlorenchym and parenchyma)		
	secondary	lateral: - cambium (forming the secondary phloem and xylem) - phellogen (forming the periderm)		
Covering	primary	epiderm with stomas epiblem with root hairs		
	secondary	periderm (consists of phellogen and its derivatives - cork and phelloderm) cork (complexs of periderms)		
Excretory	*exogenous (or external) secretory*	glandular hair, glandules, scales. nectaries, osmophores, hydatodes (or water stomas)		
	endogenous (or internal) secretory	cells-idioblasts (or secretory cells)		
		lacticifers	articulate	with anastomosis
				without anastomosis
			articulate	branched
				non-branched
		conceptacles, tubers	lysigenicous	
			schizogenous	
			schizo-lysigenicous	
Basic	chlorenchyma (or chlorophyll-containing parenchyma)	palisade (or columnar), spongy (or lacunose), folded		
	storage parenchyma			
	water-storage (or hydrophoric)			
	aerenchyma (or air-containing parenchyma)			
Mechanical	collenchyme	angular lamellar lacunar		
	sclerenchyma	sclereids libriform (or xylem, or wood fibers) bast (or phloem fibers) perivascular sheath cells cortex fibers		
Conductive	provide ascending movement water and minerals	vessels, tracheids		
	provide downward movement organic substances	sieve tube with the companion cells or without it		
Complex	xylem (wood)	mechanical – xylem (wood) fibers or libriform conductive – vessels, tracheids basic – xylem (wood) parenchyma		
	phloem (bast)	mechanical – phloem (bast) fibers conductive – sieve tube with the companion cells or without it basic – phloem (bast) parenchyma		

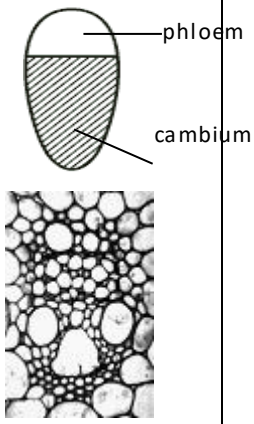
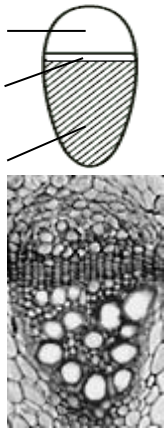
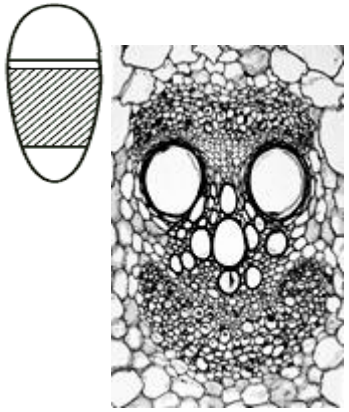
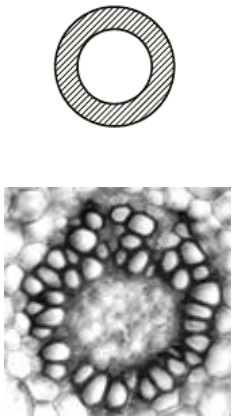
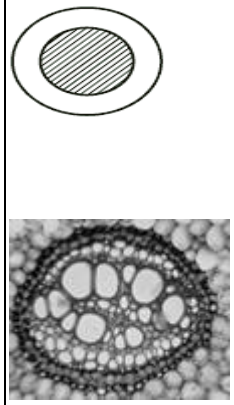
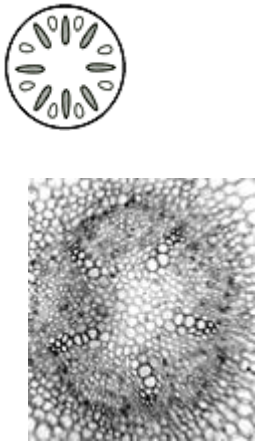
Appendix 6

The main morphological types of stomata complexes of higher plants

Type, group of plants, which are being characterized	**Structure**	***Type, group of plants, which are characterized***	**Structure**
Anomocytic type is the type where a stoma is surrounded by subsidiary cells which are similar to other epidermal cells (e.g. *Asteraceae, Ranunculaceae, Solanaceae, Papaveraceae, Urticaceae, Geraniaceae* Family etc.).		***Diacytic type*** is the type when two subsidiary cells are situated around the stoma and their adjacent side is perpendicular to the stomatic slit (e.g. *Lamiaceae, Myrtaceae* Family).	
Anisocytic type is the type where three cells are situated around the stoma, and one of them is smaller or large than others (e.g. *Cruciferae, Polygonaceae* Family, etc.).		***Tetracytic type*** is the type where the stoma with four subsidiary cells, two of them are lateral and another two are polar (family of class monocots, rarely – dicots).	
Paracytic type is the type with two subsidiary cells situated around the stoma and their longitudinal axis is parallel to the stomatic cleft (e.g. *Fagaceae, Rosaceae, Myrtaceae, Apocynaceae* Family etc.).		***Aktynocytic type*** (Greek. aktis – ray) – has 5 subsidary cells or more, they are radially elongated (flower, such as cotton, black pepper)	

Appendix 7

The types of conductive bundles and their characteristics

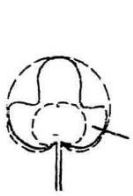
Types of bundles	collateral		bicollateral	concentric		radial
	closed	opened		centrophloem	centroxylem	
Scheme and photos						
The presence of cambium	without cambium (closed)	with cambium (opened)		without cambium (closed)		
Mutual placement of phloem and xylem	phloem outside of the xylem		phloem of the outer and inner sides of the xylem	xylem surrounds the phloem	phloem surrounds the xylem	phloem between radial rays of the xylem
Organs and classes	stems, rhizomes of *monocots*	roots of *dicots* in the conductive zone, stems, rhizomes		rhizomes of *monocots*	rhizomes of ferny	roots (*mono.*- and *dicots*) in the absorbing zone and *monocots* in conductive zones

Appendix 8

Generalized scheme of histological content of axial organs of plants

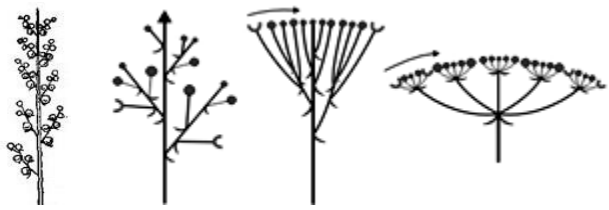
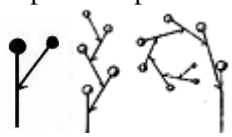
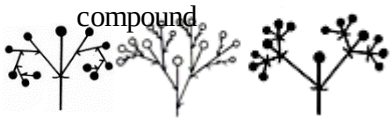
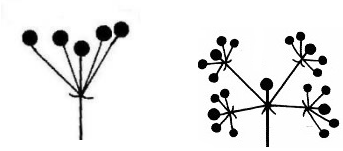
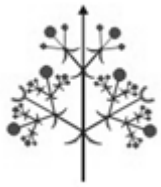
Organs		Roots			Stems of grassy plants		Rhizomes		Stems of woody plants	
Class		*monocots*	*dicots*		*monocots*	*dicots*	*monocots*	*dicots*	*angiosperms*	*gymnosperms*
Type of structure		primary	primary	secondary bundle, transitional nonfascicular type	primary	secondary bundle, transitional nonfascicular type	primary	secondary bundle, nonfascicular type	secondary nonfascicular type	
Parts of organs and their typical histological structure	Cover tissue	- epiblem (rhizoderm) with root hairs	- epiblem with root hairs	- periderm - cork	- epiderm with stomas and trichomes	- epiderm with stomas and trichomes	- epiderm with stomas and without trichomes	- periderm	- periderms with lenticels - cork	- periderm - cork with cracks
	Primary bark	- exoderm - mesoderm - endoderm with U-shaped thickening cell walls	- exoderm - mesoderm - endoderm with Casparian strips	- absent or presented parenchyma	- without endoderm, is not well developed, well developed or absent	- collenchima - storing parenchyma - endoderm (starch- or crystal-bearing)	- storing parenchyma - endoderm with U-shaped thickening cell walls	- storing parenchyma - endoderm (starchl-bearin)	remains: - cork parenchyma - collenchyma	- cork parenchyma
	Central cylinder	- pericycle, - radial bundle (xylem rays more then 6 and more)	- pericycle, - radial bundle (xylem rays not more then 6	- open collateral bundles and bicollateral are placed in a circle; - cambium, phloem i xylem are placed in a circle	- closed collateral bundles are located chaotically throughout the area of the axial cylinder	- open collateral bundles and bicollateral are placed in a circle; - bundles is absent, cambium, phloem i xylem are placed in a circle	- closed collateral bundles and centrophloem are located chaotically throughout the area of the axial cylinder	- open collateral bundles are placed in a circle; - non-fascicular type	- Elements of hard bast - sieve tubes with the companion cells and bast-fiber parenchyma (soft bast) - spring elements, autumn elements (vessels, tracheids, - pith rays)	- soft bast (sieve tubes without the companion cells) - annual rings (spring elements, autumn elements) - pith rays
		in the center - primary xylem, sclerenchyma		- in the central part - xylem	- core is not expressed or it is empty	- core is expressed or it is empty				

Varieties of the simple leaves with divided leaf blade

Types	**By the number and location of the free parts**		
	Ternate -	**Palmate -**	**Pinnate -**
Lobed (cut into the lobes with the size from 1/3 to ½ of the half-blade)	*lobe*  trilobate *lacinia (or part)*	palmatilobate	pinnatilobate
Partite (cut into the parts with the size from ½ to 2/3 of the half-blade)	tripartite	palmatipartite	pinatipartite
Dissected (cut into segments with the size from 2/3 to the main vein or base)	*segment* trisected	palmatisected	pinatisected

Appendix 10

Morphological types of inflorescences

Monopodial (botryoid, racemous)	*Sympodial (cymose)*
Simple The main axis is not branched, carries flowers on stalks or without them spike, raceme, corymb, umbel, anthodium, *head*, *corn*, catkin *(spadix)* (ament) **Compound** The main axis is branched, the lateral axis carries flowers or elementary inflorescences **Compound monopodial** composed of similar elementary inflorescences  *compound spike* *panicle*, *compound corymb* *compound umbel* **Compound heterogeneous inflorescences** consist of other elementary monopodial inflorescences *panicle of anthodiums*, *umbel-like panicle, of the anthodiums* *panicle of spikes, ect.*	**monochasiums** simple compounds  *winding* *bostryx* **dichasiums** simple compound  **pleiochasiums** **(or false umbel)**  simple compound **Thyrsus:** the main axis is growing monopodial and carries sympodialni elementary inflorescences: *raceme of bostryxes, panicle of dichasiums, ament of dichasiums ect.* *raceme of dichasiums* 

Simple monopodial inflorescences

A raceme (or cluster) – the main axis is lengthened, flowers on the pedicles. A raceme is unilateral, bilateral, dense, friable, intermittent, upright, hanging and drooping,

A spike - the main axis is lengthened; the flowers are sessile, alternate (e. g., goose-grass).

A catkin (or ament) – the main axis is drooping, deciduous, the flowers are sessile, unisexual (e.g., poplar, willow).

An umbel - the main axis is strongly shortened, the pedicles are approximately identical, go out as though from one point (e.g, cherry, onion).

A corymb - the main axis is more or less well developed, the flowers are alternate and the pedicles of the lower flowers are longer than at the overhead ones, that is why the flowers are almost at one level (e.g., pear, hawthorn).

A spadix - the main axis is vertically lengthened, thickened, the flowers are sessile (e.g, maize).

A head - the main axis is shortened, thickened; the flowers are on the very short pedicles (e.g., clover).

An anthodium (or calathium) - the main axis horizontally overgrows in a common receptacle; the flowers are sessile, small, with the characteristic of the corolla's types. Around the inflorescence there is one- or multiserial involucre from bracts.

The compound monopodium homogeneous inflorescences

(the lateral axes of the second and following order with the flowers or with the simple (elementary) monopodium inflorescences grow from the main axis (e. g., double raceme).)

A panicle - they are abundantly branching out axes of the following orders, bearing flowers, racemes (racemose panicle) or corymbs (corymbose panicle) on a protractedly growing main axis.

A compound spike consists of the elementary inflorescences - the spikelets.

A compound umbel is collected from the simple umbels, which are situated on the much shortened main axis. Near base of the pedicle axes can be bracts, which are formed involucre and involucels, respectively.

A compound corymb consists of the simple corymbs. Flowers are situated in plane.

The compound monopodium heterogeneous inflorescences

(The lateral branching and sympodial growth are characteristics of the sympodial inflorescences. They are usually closed, because an early appearing apex flower stops the development of the main axis. Growth of the inflorescence is continued by the underlying lateral shoot or lateral shoots of the following orders, which also end with flowers.)

Raceme of umbels (devil's high).
Panicles of umbels (Aralia Manchurian)
Panicles of compound ears (oat seed)
Panicles of corymbs (mountain ash, Bergenia crassifolia)
Panicle of anthodiums (wormwood)
Head of anthodiums (holovaten Rus)
Compound corymb of anthodiums (tansy, yarrow)

Sympodial inflorescences

A simple monochasium – the main axes ends with a flower. The lateral axis is the only one.

A compound monochasium - has a few lateral axes, every axis begins only from one outgrowing axis of the next order. A winding (or sulcus), bostryx, a glome are the varieties of the difficult monochasium.

A winding has lateral axes of different orders, which grow in different sides (e.g., gladiolus).

A dichasium – two lateral axes of the second and following orders are located opposite each other (e.g. carnation).

A pleiochasium (or false umbel) - the lateral axes of the following order are located verticillate, carry flowers.

Combined heterogeneous inflorescences

(are characterized with the main axis, which grows monopodialy, lateral axes grow sympodialy, and the degree of the branching of lateral axes and foundation of the inflorescence reduces to its apex)

raceme of the bostryxs (e.g., horse-chestnut),
raceme of the double winding (e.g., figwort),
corymbose thyrsus (e.g., cinquefoil),
spike-shaped thyrsus,
catkin-shaped thyrsus (e.g., birch, oak),
thyrsus from false whorls (e.g., sage)

Appendix 11

Classification of fruits

Common features	**Classification group the name of of fruits, examples of taxa**
According to participation of flower in the formation fruit components.	➢ true – formed only by ovary ➢ false – created with participation of other parts of flowers: hypanthium (fraga, cynarodium, apple), perianth (beets), calyx (fruitcase of henbane), floral and spikelet scales (cereals).
According to morphology of pericarp	➢ juicy ➢ dry explosive, ➢ dry indehiscent, ➢ dry synkarp (or break down into merykarps and half-merykarps)
According to the number of seeds	➢ many-seeded ➢ one-seeded fruit

By type of and position of gynoecium and ovary pistil	• **monocarpous** (simple): legume, follicle, nut, drupe **apocarpous** (complex, collected): polyfollicle, aggregate-accessory fruit, polynutlet, phraga, cynarodium • cenocarpous: ➢ **syncarpous, with many nests, polyspermous,** • superior: fruitcase (Solanaceae, Liliaceae); lily of the valley berries, cranberries, blueberries; hesperidiums or bitter orange (citrus); coenobium or tetranutlet (Lamiaceae); syncarpous drupes (buckthorn); cremocarp (celery); kalatch (Malvaceae), disamara (maple); regma (Euphorbiaceae); sterigma, syncarpous polyfollicle. • inferior: fruitcases; berries (blueberries); apple (apple); granatum (grenades); pirenariy or bacciform drupe (elder, bearberry). ➢ **paracarpous,** one-nests, many-seeded, • superior: fruitcase (Papaveraceae) silicle and silique (Brassicaceae); • inferior: fruitcase (Orchids); berries (gooseberries, currants); pepo (cucumber, pumpkin). ➢ **lisicarpous**, one-seeded, superior: • many-seeded: fruitcase with the column (clove); • one-seeded: nut and achene (buckwheat, amaranth) berries (mistletoe); drupy juicy nut (sea buckthorn) pirenarium (snowball). ➢ **pseudomonocarpous** one-nests, one-seeded: • superior: caryopsis (cereals), nuts (linden), wing (elm tree), dry drupe (coconut); cenocarpous drupe (olive). • inferior: achene (Asteraceae), nuts (walnut), winged nut or samara (birch), acorn (oak); dry drupe or pirenarium (walnut).

Appendix 12

Life forms (biomorfy) of plants (classification by I. Serebryakov)
(habitus of a group of plants which displays its adaptation to environmental conditions)

Woody plants (perennial woody stalks, buds of the renovation)			**Half-woody** (down part of stems are woody with buds of the renovation)	**Herbaceous plants** (the stalks are not woody) **polycarpic plants –** produce fruit many times in life, **monocarpic plants –** produce fruit only one time in life,		
deciduous and evergreen plants				aboveground and water plants		
Trees have a well-developed lignified stem; height 2-100 m and more; live from 40 to several thousand years	***Bushes (shrubs)*** main axis is replaced early by numerous side stems; height 0,6-6,0 m; live on average 3-40 years	***Dwarf subshrub*** shoots are elongated, branched, quite lignified; height 5-60 cm, shoots are live 3-10 years	***Subshrubs*** every year the elongated aboveground herbaceous shoots die off, and basal lignified shoots stored; lignified shoots length of 20-30 cm and 4-7 herbaceous - 150-200 and 20-30 cm	***annual*** full vegetation period, long or shortened (ephemera) die off annually	***biannual*** the first year formed a leaf rosette and an underground storing organ (root crop, root tuber), and the second - flowering shoots	***perennial*** full vegetation period, long or shortened (ephemeroids) Every year aboveground part dies, but kept underground storing organs from buds (bulbs, tubers, rhizomes)
Examples of some genus and species						
pine, oak, birch, mountain ash	*juniper, rose, tea*	*blueberry, cranberry, bearberry*	*salvia officinalis, periwinkle, ephedra, thyme*	*peas, fennel, calendula, Digitalis purpurea*	*carrots, sweet clover, cabbage*	*waybread, lily, nettle, elfwort*
Liana - plants with flexible unstable stems which need support						
woody *(reaching 30 m)* *vine, actinidia, ivy*		***shrub*** *(10 m)* *(Schizandra chinese, alamanda)*		***semi-shrubs*** *(Paslyon bittersweet)*		***herbaceous*** *(hop, morning glory)*
Some specific forms of plants						
pulvinate *(some species of chrysanthemum, barberry, saxifrage)*	***creeping*** *of lying stems* *(Some species of rhododendron, cotoneaster)*		***Semi-parasites and parasites*** *(mistletoe, euphrasia, dodder, broomrape)*	***succulent leaves*** *(aloe) and* ***cauline*** *(euphorbia, prickly pear)*		***epiphytes*** *(phalaenopsis, chlorophytum)*

Appendix 13

The main morphological and anatomical features families of course "Pharmaceutical Botany"

Life forms, features of stem	Features of the underground organs	Leaves: cauline, rosette	Inflorescence	Flower			Fruits	Anatomical features	Groups of BAS
				perianth - due the symmetry (correct *, incorrect ↗); - the type, double (Ca Co) simple calyciform (P^{Ca}) corolliform (P^{Co})	androecium (A)	gynoecium (G), ovary by location (superior, inferior)			
1	2	3	4	5	6	7	8	9	10
Poppy Family– *Papaveraceae*									
herbs	tap root system	stems are alternate, rosette, simple, without stipules	raceme, panicle, false umbrella	correct, double *Ca_2 Co_4	A_∞	cenocarpous superior	cenocarpous – fruitcase	lacticifers	alkaloids
Buckwheat Family– *Polygonaceae*									
herbs, ліани	tap root system; rhizomes	stems are alternate, simple, stipules filmy which are forming ocrea	spike-like raceme, panicle	correct, simple *$P_{(5-6)}$	$A_{3-9,\ 3+3}$	cenocarpous superior	cenocarpous – triangular nuts	druses. stomas are anisocytic, trichoms are bunched, glandulars and conceptacles	anthracene derivatives
Cabbage Family – *Brassicaceae*									

herbs	edible root, stem-like root	stems are alternate, rosette, simple, without stipules, heterofiliya	raceme, corymb, panicle, head	correct, double, calyx and corolla are cruciform Ca_{2+2} Co_{2+2} nectaries are present	A2+4, tetrady mous	cenocarpous superior	cenocarpous silique, silicle, loment silique	stomas are anisocytic, trichoms are appressed	
Life forms, features of stem	Features of the underground organs	Leaves: cauline, rosette	Inflorescence	Flower perianth - due the symmetry (correct *, incorrect ↗); - due the type, double (Ca Co) simple calyciform (P^{Ca}) corolliform (P^{Co})	androecium (A)	gynoecium (G), ovary by location (superior, inferior)	Fruits	Anatomical features	Groups of BAS
Legume Family – *Fabaceae*									
diverse	root nodules with nitrogen-fixing bacteria	stems are alternate, compound, with stipules, metamorphosis: tendrils, thorns	raceme, head, umbrella, spike, panicle	zigomorphous, double, corolla papilionaceous $*Ca_{(5)}$ $Co_{1+2+(2)}$	A $_{10,}$ $_{(9)+1,}$ $_{(10)}$	monocarpous superior	legume one-seeded or many-seeded, explosive or indehiscent or loment legume	epiderm with trichoms	flavonoids
Rose Family – *Rosaceae*									
Subfamily *Rosoideae*									
diverse	all kinds	stems are alternate, simple, complex, with stipules	diverse	correct, double, star-shaped corolla $*Ca_{(5)}$ Co_5	A $_{(\infty)}$	apocarpous superior	apocarpous – collected drupes, nuts, achenes; false complex: fraga,cynarodium	epidermis with trichoms or spikes	polysaccharides

Subfamily *Maloideae*									
trees, shrubs	all kinds	simple, complex, with stipules that early fall off	umbrella, corymb, compound corymb, panicle	correct, double, star-shaped corolla, *$Ca_{(5)}$ Co_5	A $_{(\infty)}$	cenocarpous, inferior, forms hypanthium	cenocarpous juicy false - apple	epidermis with trichoms	polysaccharides
Subfamily *Prunoideae*									
trees, shrubs	tap root system	alternate, simple, with stipules that early fall off	raceme, umbrella	correct, double, star-shaped corolla, *$Ca_{(5)}$ Co_5	A $_{(\infty)}$	monocarpous superior	monocarpous – drup	nectaries	in seeds - fatty oil,
Heath Family– *Ericaceae*									
shrubs, bushes, evergreen and deciduous	mycorrhizae	alternate, simple, leathery, without stipules	umbrella, corymb, raceme, panicle	correct, double, corolla is bell-shaped or choripetalous, *$Ca_{(4,5)}$ $Co_{(4,5)}$ there are nectary disk	A $_{8,10}$ anthers with appendages	cenocarpous superior, inferior	cenocarpous – berry, pirenarium, fruitcase	stomas are paracytic, anisocytic, trichoms, glandulars	alkaloids
Celery Family – *Apiaceae*									
grass, bushes, stems are hollow, ribbed	tap root system. edible root	stems are alternate, rosette; divided, simple, without stipules, vaginal	complex umbrella, with or without involucels, head	correct, double, star-shaped corolla, *$Ca_{(5)}$ Co_5 there are nectary disk	A $_5$	cenocarpous inferior	cenocarpous cremocarp	*secretory structures* (conceptacles, channels)	essential oils
Solanaceae Family – *Solanaceae*									
grass, semi-bushes	all kinds	stems are alternate, opposite, simple, without stipules	dichasium, bostryx	correct, double, corolla is bell-shaped, rotate, funnelform, tubular *$Ca_{(5)}$ $Co_{(5)}$	A $_5$ anthers are synanterous	cenocarpous superior	cenocarpous: berry, fruitcase	glandular hairs, calcium oxalate crystals	alkaloids

Figwort Family – *Scrophulariaceae*									
grass, semi-bushes, bushes, parasite, semi-parasites	all kinds	stems are alternate, rosette; simple, without stipules	raceme, ear	zigomorphous, double, corolla is bell-shaped, rotate or thimble-shape, bilabiate, bilabiate with spur $Ca_{(4,5)}$ $Co_{(4,5)}$	$A_{4,5}$	cenocarpous superior	cenocarpous – fruitcase	glandular hairs, calcium oxalate crystals	cardiac glycosides, polysaccharides
Mint Family – *Lamiaceae*									
grass, semi-bushes, bushes, stems are quadrangular	all kinds	cross-opposite, simple, without stipules	thyrsus: raceme, ear, head of dichasium	zigomorphous, calex is dentate, funnelform, tubular Ca(4,5) Co(4,5)	A 2+2 didymous	cenocarpous superior	cenocarpous, fatiscent or separating (schizocarp) – coenobium (tetranutlet)	simple and glandular hairs, glandulars	essential oils
Aster Family – *Composite*									
grass, semi-bushes, bushes,	all kinds	stems are alternate, rosette; simple, without stipules; heterofiliya	anthodium, head, panicle of anthodiums, compound corymb of anthodiums, head of anthodiums	calex is reduced, corolla is zigomorphous ligulate, false ligulate, funnelform Car∞ Co (4,5) corolla is correct, tubular *Car∞ Co (5)	A_5 anthers are synantherous	cenocarpous inferior	psudomonocarpous-monocarpous – achene	secretory structures, essential oil glands, lacticifers, conceptacles	polysaccharides, essential oil, flavonoids, alkaloids
Onion Family – *Alliaceae*									

grasses stems ate juicy	bulb, rhizome	simple, juicy, linear without stipules, vaginal	umbrella with a filmy coat	correct, corolliform *$P^{Co}_{(3+3),(6),6}$	$A_{3+3,6}$	cenocarpous superior	cenocarpous – fruitcase	lacticifers	phytoncides, essential
Grass Family – Poaceae (*Gramineae*)									
grasses, stems are full or hollow (straw)	fibrous root system or rhizome	simple, linear, with a long vagina and tongue, ears or hairs	elementary - spikes collected in a complex spike, panicle complex ears	correct, simple, reduced to filmy lodicules *$P^{r}_{2,3}$	$A_{3,6}$	cenocarpous superior	sudomonocarpous – cypsela	stem is hollow (straw)	carbohydrates, proteins

Some medicinal plants listed in the "Red Book of Ukraine"

1. *Yellow horned poppy, tulip poppy – Glaucium flavum, Papaveraceae* (Poppy) Family
2. *Mountain arnica – Arnica montana, Asteraceae* (Aster) Family
3. *Locoweed – Astragalus dasyanthus, Fabaceae* (Legume) Family
4. *Northern firmoss – Huperzia selago (Lycopodium selago), Huperziaceae* Family
5. *Belladonna – Atropa belladonna, Solanaceae* (Potato) Family
6. *False hellebore – Adonis vernalis, Ranunculaceae* (Buttercup) Family
7. *Fern leaf peony – Paeonia tenuifolia, Paeoniaceae* Family
8. *Autumn crocus – Colchicum autumnale, Liliaceae* Family
9. *Golden root – Rhodiola rosea, Crassulaceae* (Stonecrop) Family
10. *European scopolia – Scopolia carniolica, Solanaceae* (Potato) Family
11. *English yew – Taxus baccata, Taxaceae* (Yew) Family

List literature

1. Botany in figures. Text & multimedia lectures [ел. ресурс] / T. N. Gontovaya, V. P. Rudenko, Ya. S. Kichymasova, V. P. Gaponenko, M. A. Kulagina. – Електрон. текстові, граф. дані (1,31 Гб). – Х. : НФаУ, 2012. – 1 електр. опт. диск (CD-ROM); кол. сист. вимоги: ПК 486 та вище; 8 Мб ОЗУ; Win 98, WinXP, Win 7; SVGA 32768 та більше кол. ; 640x480; 4x CD-ROM дисковод; 16 біт. зв. карта. – Диск у контейнері 18x13 см.
2. Pharmaceutical botany: textbook / T. M. Gontova, A. H. Serbin, S. M. Marchyshyn et al.; edited by T. M. Gontova. – Ternopil : TSMU, 2013. – 380 p.
3. Pharmacognosy : textbook for higher school students / V. S. Kyslychenko, L. V. Upyr, Ya. V. Dyakonova e.o.; ed. by V. S. Kyslychenko. – Kharkiv : NUPh : Golden Pages, 2011. – 552 p.
4. Test items for licensing examination KROK – 1 “Pharmacy” with explains. Botany / T. N. Gontovaya, Ya. S. Kichymasova, V. P. Gaponenko, M. A. Kulagina. – Kh. : NPHU, 2013. – 69 p.
5. Збірник тестових завдань з поясненнями та ілюстраціями для контролю знань та підготовки до ліцензійного іспиту Крок 1 (ботаніка) / Т. М. Гонтова, Л. М. Сіра, В. П. Руденко та ін ; за ред. проф. Т. М. Гонтової, доц. Л. М. Сірої. – Х. : НФаУ, 2015. – 128 с
6. Систематика рослин у рисунках : Навч. посіб. / Т. В. Опрошанська, В. П. Руденко, В. В. Машталер, О. С. Мала. – Х. : НФаУ, 2015. – 65 с.
7. Фармацевтична ботаніка : підручник для вузів / Сербін А. Г., Сіра Л. М., Слободянюк Т. О., ; за ред. Л. М. Сірої. – Вінниця : Нова Книга, 2015. – 488 с.

Educational publications

Gontova Tetiana

Kriukova Yana

Gaponenko Valentina

Mashtaler Viktoria

Mala Olga

TEST ITEMS WITH EXPLAINS FOR PREPARING FOR LICENSE EXAMINATION KROK-1 "PHARMACY" (BOTANY)

Textbook for university students

Under the editorship of Kriukowa Ya. S.

Підп. до друку з авторського оригінал-макету 29.08.16
Формат 84х108 1/16. Папір друк. № 3. Друк офсетний.
Ум. друк. арк. 1,8. Наклад 50 пр. Зам. 48

Надруковано у ПП Єсін
Україна, 61072, м. Харків, пр. Леніна, 52
тел. (057) 340-60-39