

# PHARMACEUTICAL BOTANY

In two parts

Part 1

Student of 1st year \_\_\_\_\_ group

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(Full name)

Minsk BSMU 2018

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ  
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ  
КАФЕДРА ОРГАНИЗАЦИИ ФАРМАЦИИ

# ФАРМАЦЕВТИЧЕСКАЯ БОТАНИКА

## PHARMACEUTICAL BOTANY

Практикум для специальности «Фармация»

В двух частях

Часть 1



Минск БГМУ 2018

УДК 615.1:58(076.5)(075.8)-054.6

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Предназначен для студентов 1-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке по специальности «Фармация».

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## **ФАРМАЦЕВТИЧЕСКАЯ БОТАНИКА**

### **PHARMACEUTICAL BOTANY**

Практикум для специальности «Фармация»

На английском языке

В двух частях

Часть 1

Ответственная за выпуск О. В. Мушкина  
Переводчик М. В. Волочник  
Компьютерная верстка Н. М. Федорцовой

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## TRAINING AND REGISTRATION CARD

Student of \_\_\_\_\_ year \_\_\_\_\_ gr. \_\_\_\_\_ faculty \_\_\_\_\_ (II term)

Academic week	Theme of practical classes	Mark	Teacher's signature	Date of working off	Final examination
1.	Algae				
2.	Fungi. Lichenes				
3.	Division of Bryophyta. Division Lycopodiophyta				
4.	Division Equisetophyta. Division Polypodiophyta				
5.	Division Pinophyta				
6.	Morphology of the vegetative organs (class 1)				
7.	Morphology of the vegetative organs (class 2)				
8.	Morphology of generative organs. Flower. Inflorescence				
9.	Morphology of generative organs. Seed. Fruit				
10.	<b>Final class</b>				
11.	Subclasses Magnoliidae, Ranunculidae				<p><b>Credit for II term</b></p> <p>_____</p> <p><b>Date " __ " _____ 20__ г.</b></p> <p><b>Teacher's signature</b></p> <p>_____</p>
12.	Subclass Caryophyllidae				
13.	Subclasses Hamamelididae, Dilleniidae				
14.	Subclasses Dilleniidae, Rosidae				
15.	Subclass Rosidae				
16.	Subclass Lamiidae				
17.	Subclasses Lamiidae, Asteridae				
18.	Subclasses Alismatidae, Liliidae				
19.	Subclasses Liliidae, Arecidae. <b>THE CREDIT</b>				

### **Pharmacy Organization Department Regulations for Students to Follow:**

- 1. To follow safety rules in the classrooms of the Department** (the safety instruction held) and the BSMU regulations.
- 2. To come the practical classes on time** on (according to the time-table). The students who are late to the lesson **are not allowed** to attend.
- 3. The students must wear white gowns, caps, have training albums, colored pencils.** The students who do not follow these requirements are not allowed practical classes.
- 4. Missed classes must be worked off within a 2 week period.**
- 5. The students who have not worked off the missed lesson within a 2 week period are not allowed** to attend final assessment classes and credit without the Dean's permission.

With the requirements of the department is acquainted \_\_\_\_\_ 201\_\_ year \_\_\_\_\_ (signature)

**Purpose of the practice:** to study peculiarities of the structure and reproduction of bacteria and algae, their meaning for the pharmaceutical practice.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. The basis of living organisms classification.</li> <li>2. The domain of procaryote. Peculiarities of the structure of Archaeobacteria and Eubacteria. Cyanobacteria.</li> <li>3. Classification of algae.</li> <li>4. Peculiarities of the structure and reproduction of charophytes, diatoms, green, brown and red algae. Main representatives of the divisions.</li> <li>5. The meaning of Algae and Bacteria.</li> </ol>	<ol style="list-style-type: none"> <li>7. <b>Thallus</b> —</li> <li>8. <b>Phycobillins</b> —</li> <li>9. <b>Carpogonium</b> —</li> <li>10. <b>Oogamy</b> —</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. <b>Systematics</b> —</li> <li>2. <b>Algology</b> —</li> <li>3. <b>Agar-agar</b> —</li> <li>4. <b>Chromatophore</b> —</li> <li>5. <b>Conjugation</b> —</li> <li>6. <b>Laminarin</b> —</li> </ol>	<p style="text-align: center;"><b>TESTS FOR SELF-CONTROL</b></p> <ol style="list-style-type: none"> <li>1. <b>An important feature used in the taxonomy of algae, is a form of:</b> 1) cells; 2) nucleus; 3) chromatophores; 4) mitochondries; 5) rhizoids; 6) thallus.</li> <li>2. <b>Algae, which are used in medicine:</b> 1) Ulothrix; 2) Spirogyra; 3) Chara; 4) Ulva; 5) Porphyra; 6) Laminaria; 7) Fukus.</li> <li>3. <b>Choose the correct order of the systematic units of plants from the largest to the smallest:</b> 1) species → genus → order → class → type; 2) type → class → order → genus → species; 3) type → class → species → genus → order; 4) species → class → order → genus → type; 5) division → class → family → genus → species.</li> <li>4. <b>A variety of color of algae is caused by:</b> 1) camouflage; 2) peculiarities of reproduction; 3) adaptation for photosynthesis; 4) molecular mimicry, 5) adaptation to the lack of light.</li> <li>5. <b>The bacterial cell may contain:</b> 1) flagellum; 2) chromosome; 3) mesosomes; 4) lysosomes; 5) ribosomes; 6) centrosomes.</li> <li>6. <b>In the cells of algae pyrenoids performs the function of:</b> 1) the excretion; 2) synthesis of the stock of nutrients; 3) the movement; 4) genetic information storage; 5) photosensitivity; 6) photosynthesis.</li> </ol>

### OPEN TESTS

#### Fill in the gaps:

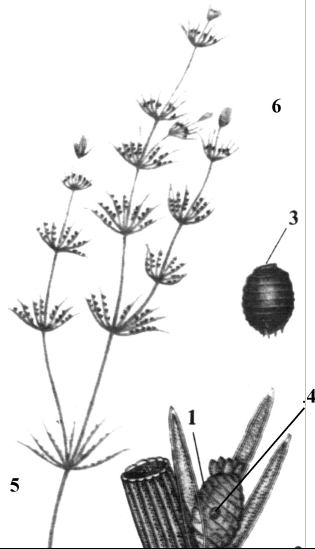
1. Storage nutrients of algae are starch, oil, ..., and hexatomic alcohol ...
2. Many algae, for example ... and ... have antitumor activity, antimicrobial, antibacterial, and antiviral effect.
3. Algae ... are used for the prevention and treatment of thyroid diseases.
4. Chara is characterized by the presence of sexual reproduction organs ... and ...
5. Algae, used for getting agar-agar ...
6. Gram-positive and gram-negative bacteria differ in structure of ...
7. ... is taken from brown algae and is used in the pharmaceutical industry.

### PRACTICAL WORK

**Task 1. Draw the preparation of Microcystis and indicate particular components. Mark the systematic position.**

**Task 2. Study the pictures and make indications.**

**Pic.1. The structure of Chara.**



- 1 –
- 2 –
- 3 –
- 4 –

Teacher's signature

**Task 3. Study the thallus of**

- a) Laminaria saccharina,
- b) Laminaria digitata,
- c) Laminaria japonica.

**Mark the systematic position of Laminaria.**





**Purpose of the practice:** to study common characteristics of the structure and reproduction, classification and representatives of Fungi and Lichens.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. Peculiarities of fungi biology.</li> <li>2. Peculiarities and representatives of Zygomycota, Ascomycota, Basidiomycota and Deuteromycota.</li> <li>3. The role of fungi in nature, medicine and agriculture.</li> <li>4. Peculiarities of the structure of lichens. Their meaning.</li> </ol>	<ol style="list-style-type: none"> <li>9. <b>Isidia</b> –</li> <li>10. <b>Soredia</b> –</li> <li>11. <b>Zygogamy</b> –</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. <b>Mycelium</b> –</li> <li>2. <b>Sclerotia</b> –</li> <li>3. <b>Hyphae</b> –</li> <li>4. <b>Conidia</b>–</li> <li>5. <b>Archicarp</b> –</li> <li>6. <b>Ascus</b> –</li> <li>7. <b>Hymenophore</b> –</li> <li>8. <b>Basidium</b> –</li> </ol>	<p style="text-align: center;"><b>TESTS FOR SELF-CONTROL</b></p> <ol style="list-style-type: none"> <li>1. <b>A common feature of Penicillium and Aspergillus is:</b> a) autotrophy; b) mycelium with racemosa sporangiophores; c) unicellularity; d) the presence of the cell wall; e) endogenous spores.</li> <li>2. <b>Isogamy is:</b> a) a process of the fusion of the gametes of different size; b) a process of the fusion of the gametes with the same morphology; c) a fertilization of the large fixed ovum by the small mobile sperm; d) the process of merging the contents of two cells of vegetative mycelium.</li> <li>3. <b>The sexual process of Ascomycetes is:</b> a) gametangiogamy; b) isogamy; c) somatogamy; d) heterogamy; e) oogamy.</li> <li>4. <b>Penicillium refers to:</b> a) mold fungi; b) yeasts; c) rust breads; d) parasitic fungi; e) pileate fungi.</li> <li>5. <b>Which fungi can't reproduct sexually?</b> a) Zycomycetes; b) Ascomycetes; c) Basidiomycetes; d) Deuteromycetes; e) Chytridiomycetes.</li> <li>6. <b>Fruit body of ergot:</b> a) perithecium; b) apothecium; c) skrerotium; d) cleistocarp.</li> <li>7. <b>Autotrophic and heterotrophic (fungi) components of the lichen body may exist:</b> a) individually; b) only in symbiosis; c) cyanobacteria and algae can exist individually, mushrooms can't exist without autotrophic</li> </ol>

components; d) mushrooms can exist independently, autotrophic components can exist only in the lichen; e) cyanobacteria, algae and animals — independently, fungi — only with autotrophic components.

8. **Officially used in medicine:** a) Tinder polypore; b) Chaga; c) Amanita; d) Boletus; e) Agaricus.
9. **Division of fungi with multicellular mycelium, no organs of sexual reproduction. Characterized by fusion of two vegetative haploid cells forming dikaryons. Most have fruit bodies formed from dikaryotic mycelium.** a) Zycomycetes; b) Ascomycetes; c) Basidiomycetes; d) Deuteromycetes; e) Chytridiomycetes.
10. **Division of fungi with multicellular mycelium. Characterised by asexual reproduction by conidia. Representatives — Fusarium, Penicillium, Aspergillus.** a) Zycomycetes; b) Ascomycetes; c) Basidiomycetes; d) Deuteromycetes; e) Chytridiomycetes.

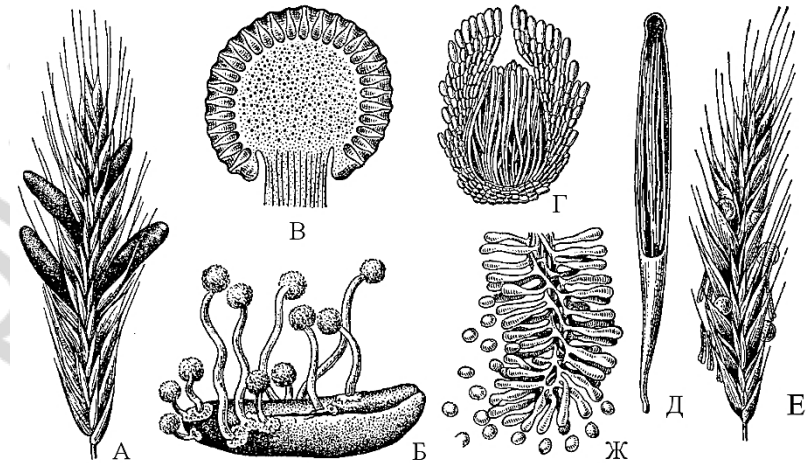
### OPEN TESTS

#### Fill in the gaps:

- The science that studies fungi ...
- The alkaloids of ergot ...
- ... layer of sacs with sterile filaments or fibres — paraphysis.
- Symbiosis of the mycelium of fungus and the roots of higher plants — ...
- Smut and ergot parasitize on ... cultures.
- Cap and stipe form ... of blewits.

### PRACTICAL WORK

**Task 1. Study the structure of *Claviceps purpurea*. Mark the syste-matic position. Make indications.**



- sac;
- “honey-dew” on a rye’s head;
- conidiophores with conidia;
- perithecium with sacs;
- rye’s head with ergot;
- germinated sclerotia with stroma;
- stroma

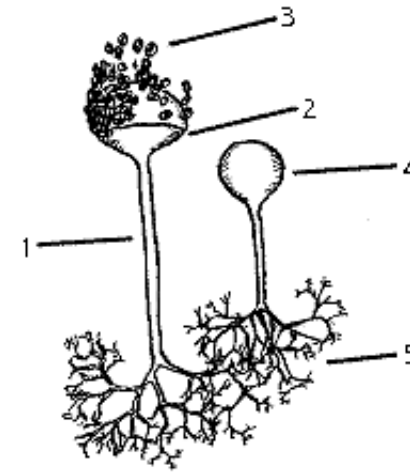
**Task 2. Study the collections of Lichens.**

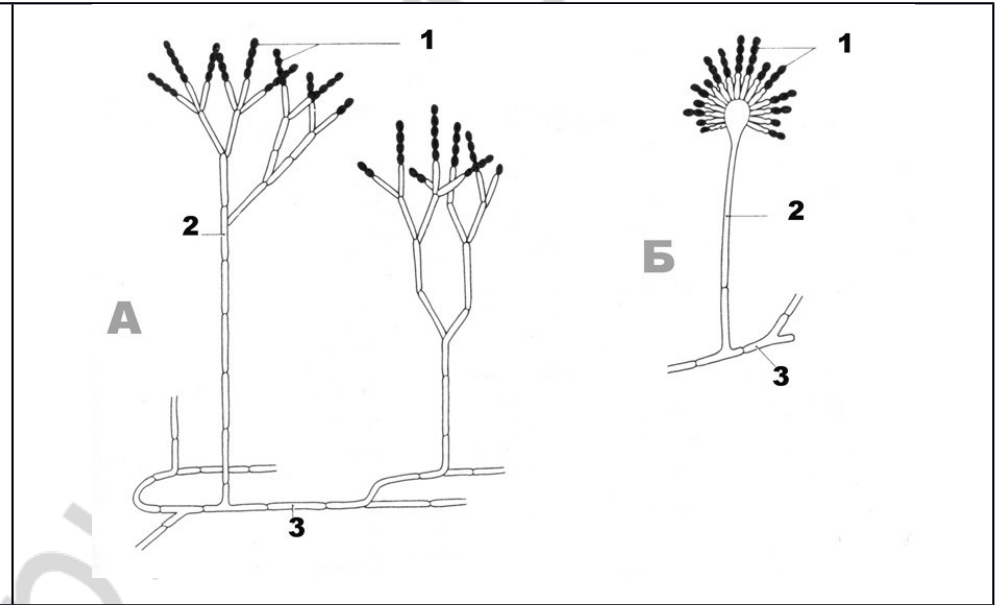
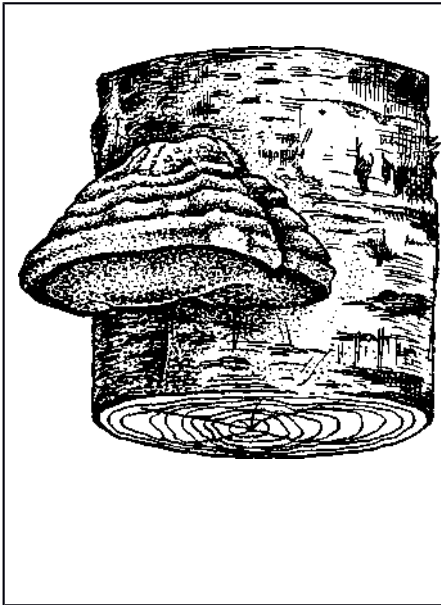
7. According to the shape of thallus *Cladonia alpine* lichen refers to ...
8. Ascomycetes can have 3 types of fruit bodies: ..., ... ..
9. Hymenomycetes include 2 orders ... and ...
10. Sexual process which is typical for *Mucor* ...
11. The shortest stage in the development of Ascomycetes ...
12. Fungus ... is producing cephalosporin. The alkaloids of ergot ...

**Task 3. Study the pictures of Chaga and the fruit body of *Tinder polypore*. Indicate the diagnostic differences. Mark the systematic position.**



**Task 4. Study the structure of *Penicillium*, *Aspergillus* and *Mucor*. Mark the systematic position. Make indications.**





Teacher's signature

**Purpose of the lesson:** to explore the features of the structure and reproduction of Bryophyta and Lycopodiophyta, their importance in the national economy and medicine.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. General characteristics of Plants Kindom.</li> <li>2. Division of Rhiniophyta.</li> <li>3. Features of the structure and position of Bryophyte in the system of the plant world's flora's evolution.</li> <li>4. Features of the structure and the development cycle of moss <i>Polytrichum commune</i>.</li> <li>5. Biological features, the value of sphagnidae.</li> <li>6. Features of the structure and development cycle representatives of the Lycopodiophyta.</li> <li>7. The value of mosses and lycopodiophyta in medicine, nature, the national economy.</li> </ol>	<ol style="list-style-type: none"> <li>8. <b>Prothallium</b> –</li> <li>9. <b>Protonema</b> –</li> <li>10. <b>Sfagnol</b> –</li> </ol> <p style="text-align: center;"><b>TESTS FOR SELF-CONTROL</b></p> <ol style="list-style-type: none"> <li>1. <b>Plants <i>Polytrichum commune</i> absorb water and mineral salts from the soil with:</b> a) roots; b) the entire surface of the body; c) rhizoids; d) rhizome; e) dead cells.</li> <li>2. <b><i>Sphagnum</i> plants become silvery-white during long drought. This is explained by:</b> a) the withering away of the plant; b) loss of water by aquifer cells and filling them with air; c) the destruction of chlorophyll; d) dropping of the leaves; e) they are always like that.</li> <li>3. <b>Unlike the lycopods sexual generation of mosses:</b> a) prevails in the lifecycle; b) is diploid; c) is morphologically associated with asexual; d) has antheridia.</li> <li>4. <b>What is the role of the aquatic environment in the sexual reproduction of mosses:</b> a) spores germinate in it; b) gametes are formed in it; c) by water spermatozoa reach archegonia where fertilization occurs; d) sex cells are excreted in the water, where they coalesce; e) it is necessary for the germination of the zygote.</li> <li>5. <b>Select features of alternation of generations in the development cycle of Lycopodiophyta?</b> a) gametophyte dominates over sporophyte; b) sporophyte parasitic on the gametophyte; c) gametophyte and sporophyte have equal development; d) there is no clear alternation of generations; e) gametophyte and sporophyte live in isolation from each other</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. <b>Rhizoids</b> –</li> <li>2. <b>Archegonium</b> –</li> <li>3. <b>Antheridium</b> –</li> <li>4. <b>Gametophyte</b> –</li> <li>5. <b>Sporophyte</b> –</li> <li>6. <b>Sporophyll</b> –</li> <li>7. <b>Spore</b> –</li> </ol>	

**6. Division Bryophyte includes classes:** a) Hepaticopsida; b) Hepaticopsida, Anthocerotopsida; c) Hepaticopsida, Anthocerotopsida, Bryopsida; d) Hepaticopsida, Anthocerotopsida, Bryopsida, Isoëtopsida; e) Lycopodiophyta, Hepaticopsida, Bryopsida.

#### OPEN TEST

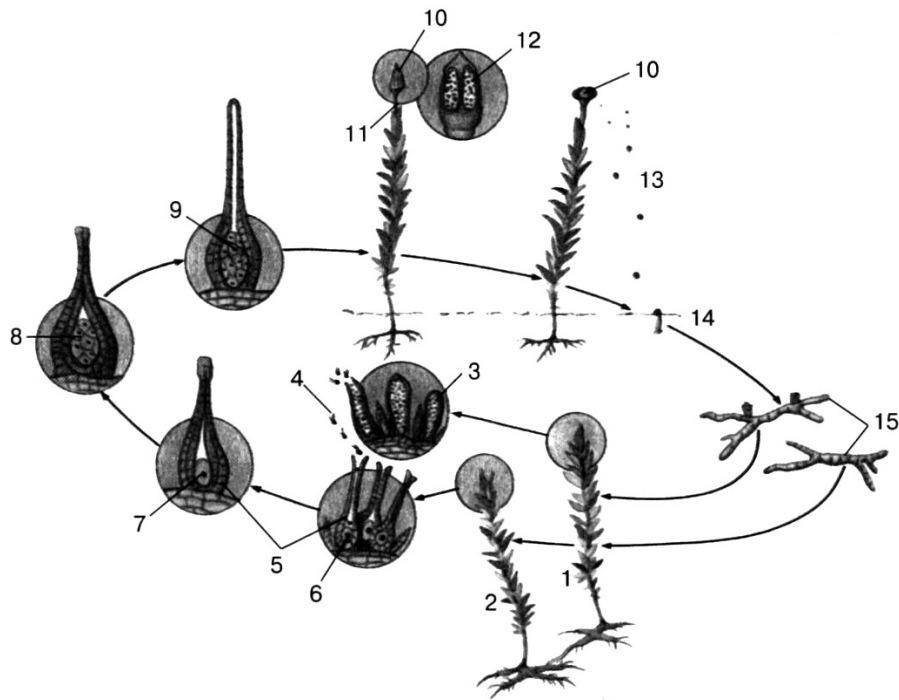
##### Fill in the missing word or concept

1. Section of biology studying mosses — ...
2. In the representatives of the bryophytes in the life cycle ... dominates over.
3. A box on a stalk is ... generation of moss.
4. From spore *Lycopodium clavatum* grows up ... — bisexual gametophyte of Lycopodium.
5. Sphagnum mosses form ..., which is widely used as fuels, fertilizer, raw materials in the chemical industry.

#### PRACTICAL WORK

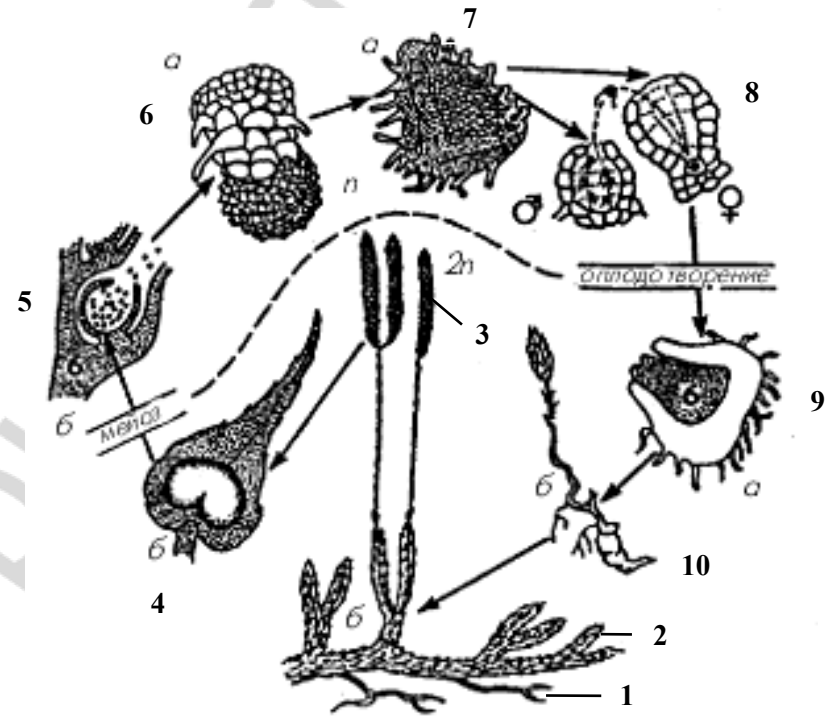
**Task 1. Study the preparations of sporogonium, antheridia and archegonium of *Polytrichum commune*. Sketch.**

**Task 2. Examine the development cycle of the Polytrichum commune.**



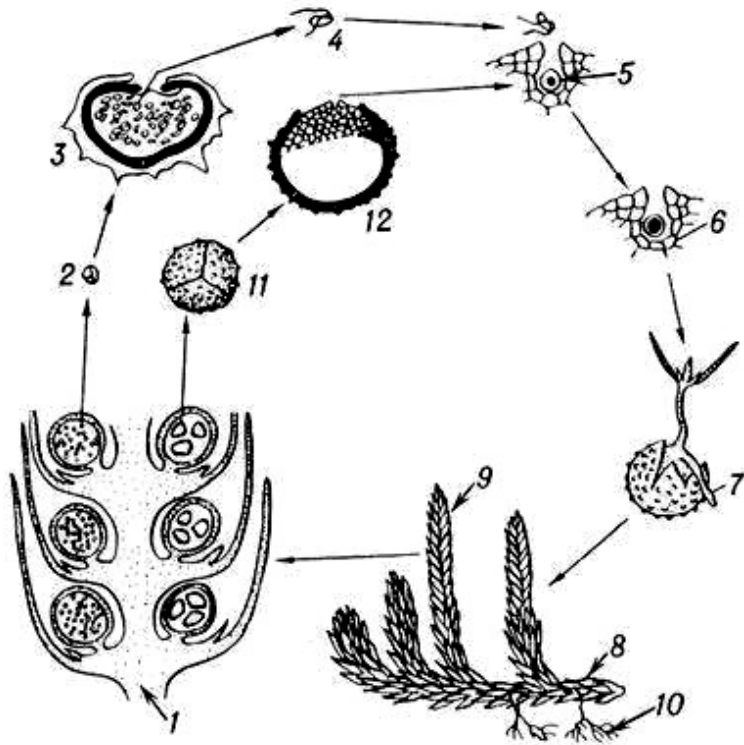
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| 2 – | 10 – |
| 3 – | 11 – |
| 4 – | 12 – |
| 5 – | 13 – |
| 6 – | 14 – |
| 7 – | 15 – |
| 8 – |      |

**Task 3. Examine the development cycle of Lucopodium clavatum commune.**



- |     |      |
|-----|------|
| 1 – | 6 –  |
| 2 – | 7 –  |
| 3 – | 8 –  |
| 4 – | 9 –  |
| 5 – | 10 – |

Task 4. Study the structure and life cycle of Selaginella. Make notations. Give full systematic position.



- 1 –
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- 6 –

- 7 –
- 8 –
- 9 –
- 10 –
- 11 –
- 12 –

Teacher's signature



**Purpose of the lesson:** to explore the features of the structure, reproduction and meaning of the main representatives of departments Equisetophyta, Polypodoiphyta.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. Features of the structure and the development cycle of Equisetophyta.</li> <li>2. Features of the structure and the development cycle of Polypodoiphyta.</li> <li>3. The value of Equisetophyta and Polypodoiphyta in medicine, nature, the national economy.</li> </ol>	<p><b>8. Heterospory –</b></p> <p style="text-align: center;"><b>TESTS FOR SELF-CONTROL</b></p> <ol style="list-style-type: none"> <li><b>1. Unlike the lycopodium, horsetail are characterized by the following features:</b> 1) gametophyte eats saprotrophly; 2) formation mostly of dioecious prothallia; 3) need of water for fertilization; 4) forming of non-chlorophyll spore sprouts; 5) gametophyte exists independently from the sporophyte.</li> <li><b>2. The ancestors of polypodoiphyta are:</b> 1) bryophyte; 2) lycopodiophyta; 3) seaweeds; 4) rhyniopsida; 5) equisetophyta; 6) psilophytes.</li> <li><b>3. Unlike the lycopodiums, ferns are characterized by the following features:</b> 1) nutrition of the gametophyte at the expense of sporophyte; 2) leaves — frond; 3) presence of vascular conduction system; 4) the presence of adventitious roots; 5) the presence of photosynthetic prothallia.</li> <li><b>4. The leaves of ferns perform functions:</b> 1) only photosynthesis; 2) transpiration and gas exchange; 3) only sporification; 4) photosynthesis, transpiration, gas exchange and sporification, 5) only gas exchange.</li> <li><b>5. For the polypodoiphyta typical features are:</b> 1) the absence of real leaves; 2) development of the gametophyte within the limits of sporophyte; 3) formation of prothallia; 4) fertilization in the presence of water; 5) the presence of rhizoids in sporophyte.</li> <li><b>6. From the spores of fern, is formed:</b> 1) multicellular gametophyte; 2) adult plant with sporangia; 3) thin long branched thread — protonema; 4) prothallium; 5) sporophyte; 6) cormophyte plant with fronds and rhizome.</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li><b>1. Elaters –</b></li> <li><b>2. Frond –</b></li> <li><b>3. Indusium –</b></li> <li><b>4. Sori –</b></li> <li><b>5. Exine –</b></li> <li><b>6. Intine –</b></li> <li><b>7. Makrofilij –</b></li> </ol>	

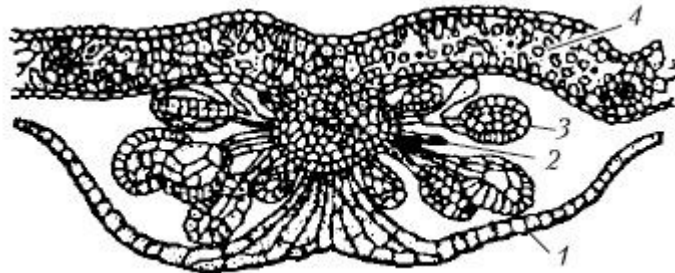
### OPEN TEST

#### Fill in the gaps:

1. Archegonia in ferns are formed on ...
2. Each spore of the horsetail contains ribbon-like appendages — ... holding some spores together and facilitating their joint growth.
3. Vegetative shoots of horsetail ... are used in medicine as a diuretic.
4. Lycopodiophyta, horsetail and ferns came from ...
5. Division Polypodiophyta includes classes: ... and ...
6. Gametophyte in fern is a ...
7. The stem of the horsetail is impregnated ... and covered with a waxy bloom.
8. Antheridia in horsetails are formed by ...

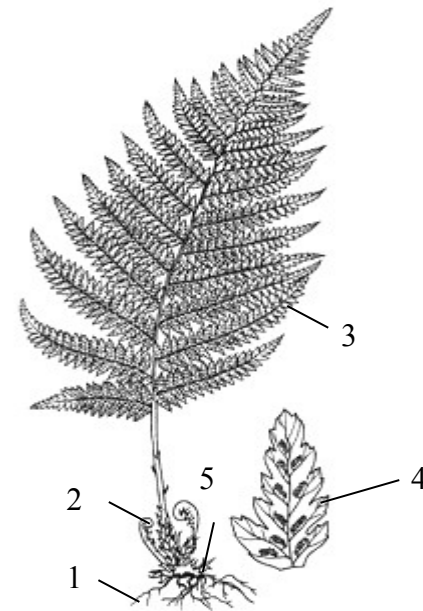
### PRACTICAL WORK

**Task 1. Study drug «Cross section of Sori of *Dryopteris filix mas*»  
Make notations.**



- 1 –
- 2 –
- 3 –
- 4 –

**Task 2. Study drug leaf of fern. Make notations.**



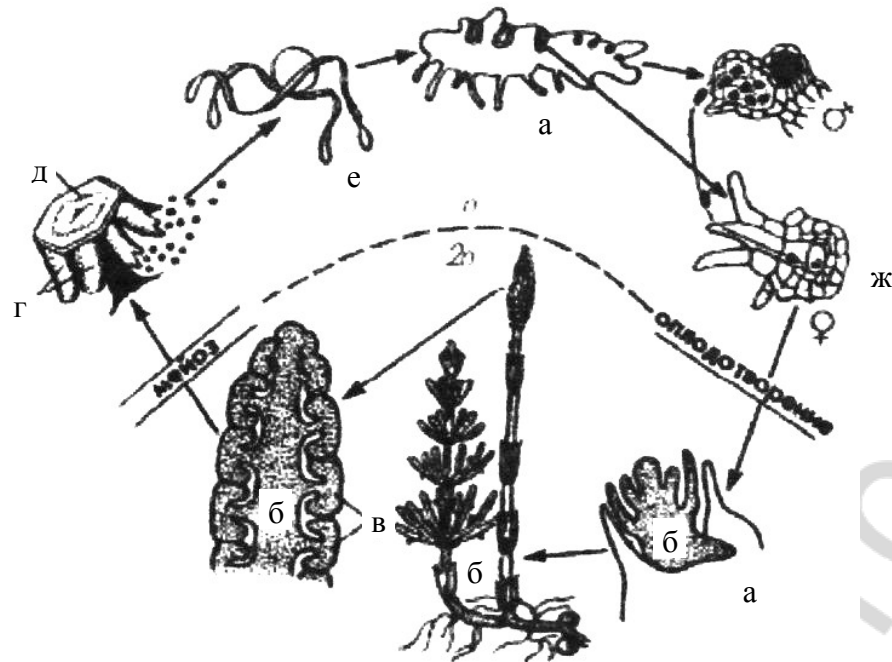
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Task 3. Fill in the table.

Kind	Diagnostic features			
	the direction of the main shoots	characteristic of the lateral branches	characteristic of teeth sheaths of stem	typical habitats
<i>Equisetum arvense L.</i>				
<i>Equisetum palustre L.</i>				
<i>Equisetum pratense Ehrh</i>				
<i>Equisetum sylvaticum L.</i>				
<i>Equisetum fluviatile L.</i>				

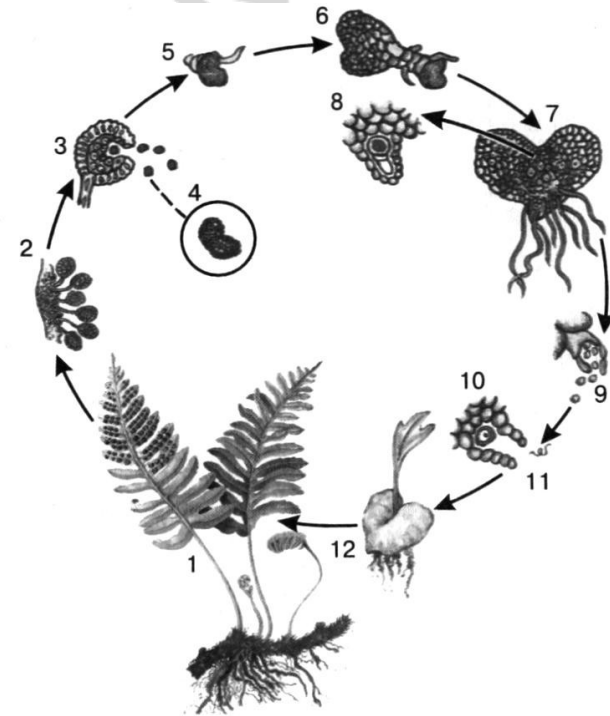
**Task 4. Examine development cycle of horsetail and fern. Designate parts of the sporophyte and gametophyte.**

Examine development cycle of *Equisetum arvense*



- а –
- б –
- в –
- г –
- д –
- е –
- ж –

**Task 5. Examine development cycle of fern.**



- 1 –
- 2 –
- 3 –
- 4 –
- 5 –
- 6 –
- 7 –
- 8 –
- 9 –
- 10 –
- 11 –
- 12 –

Teacher's signature

**Purpose of the lesson:** to explore the features of the biology, structure, reproduction and importance of the gymnosperms.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. Progressive signs of gymnosperms in the structure and reproduction in comparison with spore plants.</li> <li>2. The structure of the strobili, seeds of the gymnosperms.</li> <li>3. Features of the development cycle of gymnosperms (on the example of Scots pine).</li> <li>4. Classification of the gymnosperms.</li> <li>5. The value of gymnosperms in medicine, nature, national economy.</li> </ol>	<ol style="list-style-type: none"> <li>7. <b>Phytoncides</b> –</li> <li>8. <b>Needles</b> –</li> <li>9. <b>Microsporophylls</b> –</li> <li>10. <b>Macrosporophylls</b> –</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. <b>Integument</b> –</li> <li>2. <b>Endosperm</b> –</li> <li>3. <b>Mycorrhizas</b> –</li> <li>4. <b>Strobili</b> –</li> <li>5. <b>Nucellus</b> –</li> <li>6. <b>Galipot (resin)</b> –</li> </ol>	<p style="text-align: center;"><b>TESTS FOR SELF-CONTROL</b></p> <ol style="list-style-type: none"> <li>1. <b>Select the features of the gymnosperms that distinguish them from the polypodiophyta:</b> 1) gametophyte — the pollen grain; 2) megasporangy is modified in the ovule; 3) the presence of tracheids; 4) female gametophyte has archegonia; 5) male gametophyte is reduced; 6) the fertilization does not depend on water.</li> <li>2. <b>Describe the male cones of the gymnosperms:</b> 1) on each squama — 2) sporangium; 2) after fertilization cones begin to grow intensively; 3) cones in the form of small yellow spikelets; 4) cone — a gametophyte.</li> <li>3. <b>Characterize the structure of the vegetative organs of the gymnosperms:</b> 1) there are no mechanical tissue in timber; 2) the presence of tracheids; 3) only fibrous root system; 4) leaves are reduced.</li> <li>4. <b>As a result of the division of spermatogenic cell of gymnosperms is formed:</b> 1) two spermatozoons; 2) two sperms; 3) microspores; 4) macrospores; 5) seed.</li> <li>5. <b>Female pine's gametophyte is formed from:</b> 1) female cone; 2) ovule; 3) macrospore; 4) endosperm; 5) groups of the cells of microspore which is dividing.</li> </ol>

**6. Class Pinopsida includes orders:** 1) Pinales and Bennettitopsida; 2) Cycadopsida and Cupressales; 3) Gnetopsida and Ephedrales; 4) Welwitschiales and Taxales; 5) Cupressales and Pinales.

**7. Name the family to which *Juniperus communis* L. belongs:** 1) Pinaceae; 2) Taxaceae; 3) Cupressaceae; 4) Podocarpaceae; 5) Taxodiaceae

**8. Characterize the structure of seeds of gymnosperms:** 1) consists only of a fetus and endosperm; 2) fetus has root, stem, some cotyledons; 3) the endosperm is formed before fertilization; 4) the fetus is not protected by the seed coat.

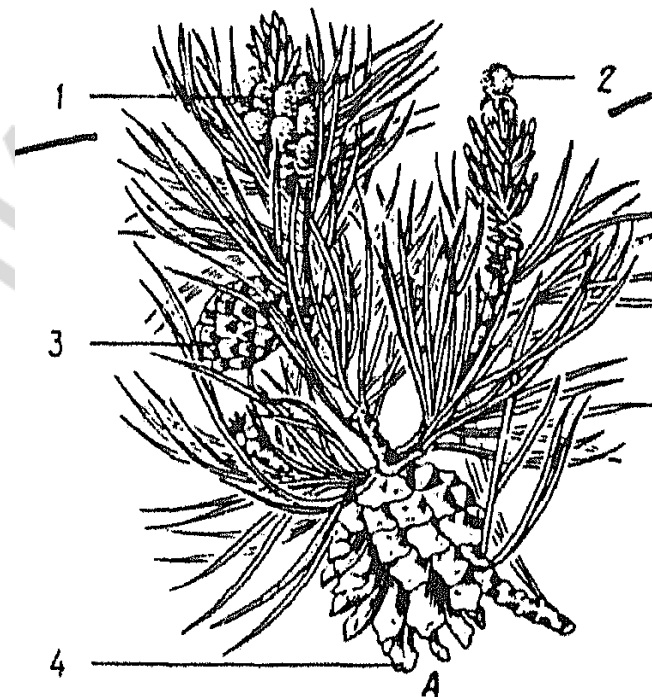
**9. In the department of gymnosperms the largest number of species is represented by the class:** 1) Ginkgoopsida; 2) Gnetopsida; 3) Cycadopsida; 4) Pinopsida.

#### FILL IN THE GAPS

1. Large leafy plant of conifers is ...
2. Male gametophyte of pine ...
3. Female gametophyte of gymnosperms ...
4. ... cones appear on the tops of young shoots, a ... cones at the base of young branches.
5. Class Pinopsida includes 2 subclass: ... and ...
6. In the representatives of the class ... of gymnosperms, a secondary timber has vessels in the stem, resin passages are missing, leaves are opposite, germs are dicotyledonous.
7. In *Pinus sylvestris* needles are long and located on the ... in the beam.

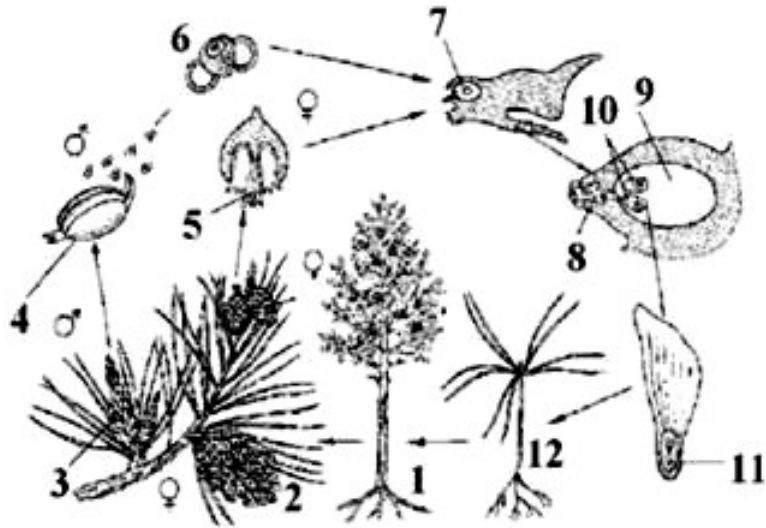
#### PRACTICAL WORK

**Task 1. Examine the herbarium samples of Scots pine. Pay attention to the features of the structure and arrangement of needles, male and female cones.**



- 1 –
- 2 –
- 3 –
- 4 –

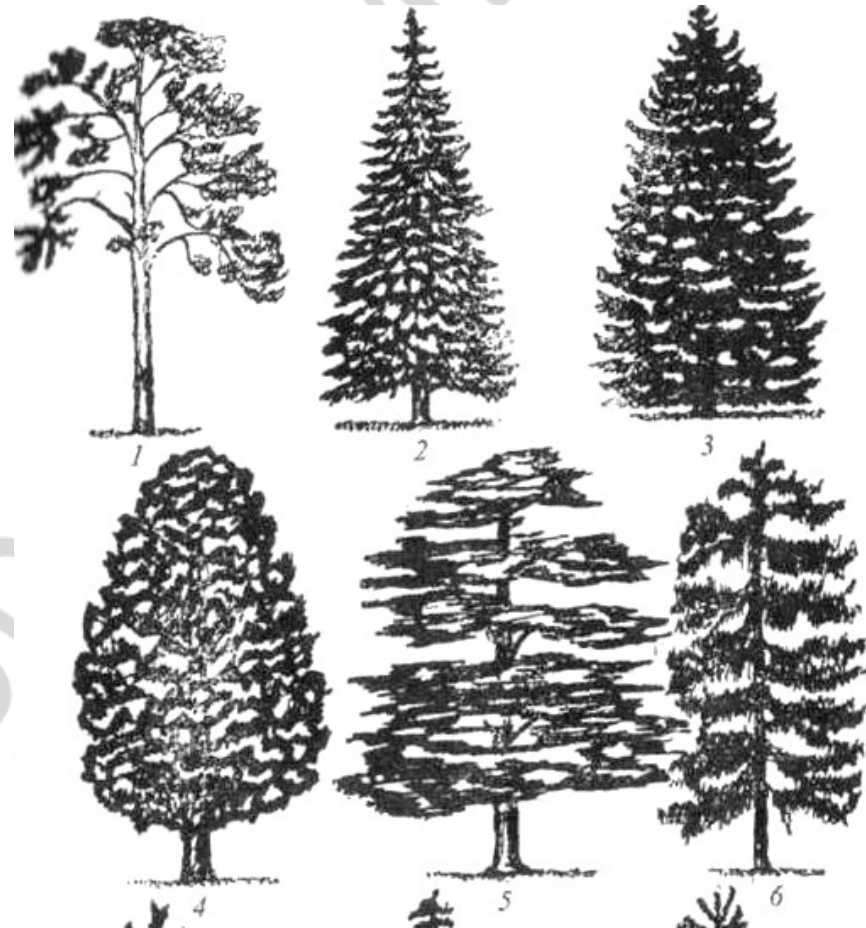
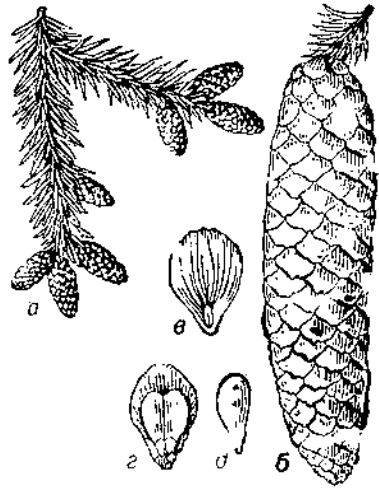
**Task 2. Examine the development cycle of the *Pinus sylvestris*.**



- |     |      |
|-----|------|
| 1 – | 7 –  |
| 2 – | 8 –  |
| 3 – | 9 –  |
| 4 – | 10 – |
| 5 – | 11 – |
| 6 – | 12 – |

**Task 3. Explore herbarium samples of gymnosperms. Make signatures, identify plants.**





Scots pine  
*Cedrus libani*  
*Larix sibirica*  
*Picea abies*  
*Abies sibirica*  
*Pinus sibirica*

**Teacher's signature**



**Purpose of the practice:** to study structural features and morphological signs of root and stem.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. The structure of the root, its functions.</li> <li>2. Types of roots.</li> <li>3. The root system.</li> <li>4. Roots' metamorphosis.</li> <li>5. Features of stem morphology, its functions.</li> <li>6. The origin of the stem.</li> <li>7. Types of stem branching.</li> <li>8. Vegetative organs modifications.</li> </ol>	<ol style="list-style-type: none"> <li>9. Mycorrhiza –</li> <li>10. Bulb –</li> <li>11. Stolon –</li> <li>12. Root vegetable –</li> <li>13. Root-tuber –</li> <li>14. Rhizome –</li> <li>15. Tuber –</li> <li>16. Bud –</li> <li>17. Long shoots –</li> <li>18. Short shoots –</li> <li>19. Branching of shoots –</li> <li>20. Cladode –</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. Metamorphosis –</li> <li>2. Tap root –</li> <li>3. Lateral root –</li> <li>4. Adventitious root –</li> <li>5. The root system –</li> <li>6. Fibrous root system –</li> <li>7. Taproot system –</li> <li>8. Mixed root system –</li> </ol>	

### TESTS FOR SELF-CONTROL

1. **Vegetative organs of plants are:** a) rhizome and cone; b) flower and fruit; c) flower and inflorescence; d) strobilus; e) shoot and root; e) leaf and tuber.
2. **Root does not perform the function:** a) transport; b) absorption of water with minerals from the soil; c) transpiration; d) reproduction; e) breathing.
3. **Rhizome is different from the root with:** a) horizontal arrangement in the soil; b) the presence of reduced leaves; c) the presence of leaf scars; d) absence of the root cap; e) all listed features.
4. **The position on the shoot buds distinguish:** a) mixed and apical; b) open and closed; c) wintering and resting; d) vegetative and generative; e) apical and lateral.
5. **Stem branching occurs due to:** a) the formation of the leaves on the stem; b) the formation of lateral shoots; c) the formation of flowers and inflorescences; d) the root shoots; e) growth of side shoots from the buds; e) activity of intercalary meristems.
6. **Root nodules is a metamorphosis of:** a) main root; b) lateral roots of the main root; c) adventitious roots; d) shoot; e) rhizome.

### FILL IN THE GAPS

1. Taproot system is characteristic for the class ...
2. Fibrous root system is characteristic for the class ...
3. At the roots of plants of the family ... there are special formations — nodules in which bacteria of the genus *Rhizobium* colonize.
4. Tuber differs from bulbs with presence of ...
5. Stem of the bulb is ...
6. Underground shoot, expanded part of which forms tubers ...
7. Stem with leaves and buds, which grows up in one vegetative period, is called ...
8. Areas of stem between neighboring nodes — ...

### SCHEME OF MORPHOLOGICAL DESCRIPTION OF VEGETATIVE ORGANS

#### STEM – characteristic

origin:

1. upright
2. ascending
3. creeping
4. climbing
5. curly

the length of internodes:

1. shortened
2. elongated

cross-section of the stem:

1. round(hollow, filled)
2. flattened
3. three-, four-, multifaceted
4. winged

the character of the surface:

1. smooth
2. grooved or ribbed
3. naked or tomentous

branching:

1. apical, dichotomous rise (equal forcipate or unequal)
2. lateral, monopodial rise of lateral axes
  - alter native
  - opposite
  - whorled
3. sympodial
  - monohazy
  - dihazy
  - pleyohazy
4. tillering
5. columnar

<b>LEAF</b> – characteristic		<b>ROOT</b> – characteristic:	
attachment to the stem:	<ol style="list-style-type: none"> <li>1. sessile</li> <li>2. petiolate</li> <li>3. clasping</li> <li>4. perfoliate</li> <li>5. ochreate</li> </ol>	origin	<ol style="list-style-type: none"> <li>1. main</li> <li>2. lateral</li> <li>3. adventitious</li> </ol>
shape of leaf edge:	<ol style="list-style-type: none"> <li>1. entire</li> <li>2. serrate</li> <li>3. denticulate</li> <li>4. crenate</li> <li>5. sinuate</li> <li>6. spiny</li> <li>7. undulate</li> <li>8. doubly serrate</li> <li>9. bidentate</li> </ol>	type of root system	<ol style="list-style-type: none"> <li>1. taproot</li> <li>2. fibrous</li> <li>3. mixed</li> </ol>
venation	<ol style="list-style-type: none"> <li>1. arcuate</li> <li>2. parallel</li> <li>3. pinnate (<i>pinnate outside, pinnate fundiform, pinnate reticulate</i>)</li> <li>4. palmate (<i>palmate outside, palmate fundiform, palmate reticulate</i>)</li> </ol>	<b>RHIZOME</b> – characteristic	
leaf structure:	<ol style="list-style-type: none"> <li>1. simple</li> <li>2. compound (<i>palmately compound, biternate, bipinnate: paripinnate and imparipinnate</i>)</li> <li>3. bi- and <u>trifoliate</u></li> </ol>	location in space:	<ol style="list-style-type: none"> <li>1. horizontal</li> <li>2. obliquely upward directed</li> <li>1. curved</li> <li>2. the twisted</li> </ol>
shape:	<ol style="list-style-type: none"> <li>1. round</li> <li>2. ovoid</li> <li>3. elliptical</li> <li>4. oblong</li> <li>5. lanceolate</li> <li>6. linear</li> </ol>	the length of internodes:	<ol style="list-style-type: none"> <li>1. shortened</li> <li>2. elongated</li> </ol>
		shape:	<ol style="list-style-type: none"> <li>1. cylindrical</li> <li>2. conical</li> <li>3. many-headed</li> <li>4. oval</li> <li>5. beaded</li> </ol>
		branching:	<ol style="list-style-type: none"> <li>1. simple</li> <li>2. branched</li> </ol>
		the character of the surface:	<ol style="list-style-type: none"> <li>1. smooth</li> <li>2. wrinkled</li> </ol>

**PRACTICAL WORK**

**Task 1. Describe the diagnostic morphological characters of the stem and root on the herbarium specimen example.**

**Teacher's signature**

**Purpose of the lesson:** to study structure features and morphological characteristics of the leaf.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. The structure of the leaf.</li> <li>2. Simple and compound leaves, classification, examples.</li> <li>3. The leaf blade — the form, the character of edge, venation, the type of dissection of blade.</li> <li>4. Metamorphosis of the leaf.</li> </ol>	<ol style="list-style-type: none"> <li>9. <b>Heterophylly</b> –</li> <li>10. <b>Leaf mosaic</b> –</li> <li>11. <b>Defoliation</b> –</li> <li>12. <b>Stipules</b> –</li> <li>13. <b>Venation</b> –</li> <li>17. <b>Ochrea</b> –</li> <li>18. <b>Dissection of leaf</b> –</li> </ol> <p style="text-align: center;"><b>TESTS FOR SELF-CONTROL</b></p> <ol style="list-style-type: none"> <li>1. <b>Functions of leaf veins:</b> a) delivering water, mineral salts and organic substances; b) photosynthesis; c) reserving water; d) transpiration; e) removal of metabolic products; f) mechanical.</li> <li>2. <b>The leaf with the leaf blade reaching the main venues called:</b> a) lobed; b) parted; c) sected; d) complex; e) modified.</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. <b>Leaf</b> –</li> <li>2. <b>Petiole</b> –</li> <li>3. <b>Emergence</b> –</li> <li>4. <b>Spines</b> –</li> <li>5. <b>Rachis</b> –</li> <li>6. <b>Lobed leaves</b> -</li> <li>7. <b>Parted leaf</b> –</li> <li>8. <b>Compound leaf</b> –</li> </ol>	

3. Determine the type of phyllotaxy in the picture:

a) alternative or spiral; b) opposite; c) crosswise opposite; d) whorled; e) rosette.

4. For leaves of dicots the typical venation is:

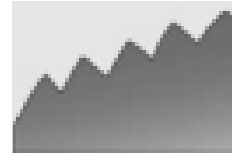
a) parallel; b) curved; c) dichotomous; d) palmate; e) spiral.

5. If the leaf base is growing significantly, enclosing the stem, there may form: a) leaf sheath; b) trumpet; c) petiole; d) rachis; e) stipules.

6. Metamorphoses of the leaf are: a) trapping apparatus; b) rhizomes; c) haustorium; d) phylloclades; e) stolons.

7. The picture shows the edge of the leaf: a) serrated; b) toothed; c) cremated; d) emarginated; e) entire.

8. If each node of the stem departs three or more leaves then such phyllotaxy is called: a) opposite; b) alternative; c) whorled; d) spiral; e) monopodial.



**OPEN TESTS**

Insert the missing word or concept.

1. The juts of the parted leaf blade are called ...

2. The picture shows a \_\_\_\_\_ leaf.

3. The dual lateral juts at the base of the leaf are called ...

4. How do we call a leaf, the leaflets of which are located all over the whole length of the rachis and the two leaflets placed on top of it?

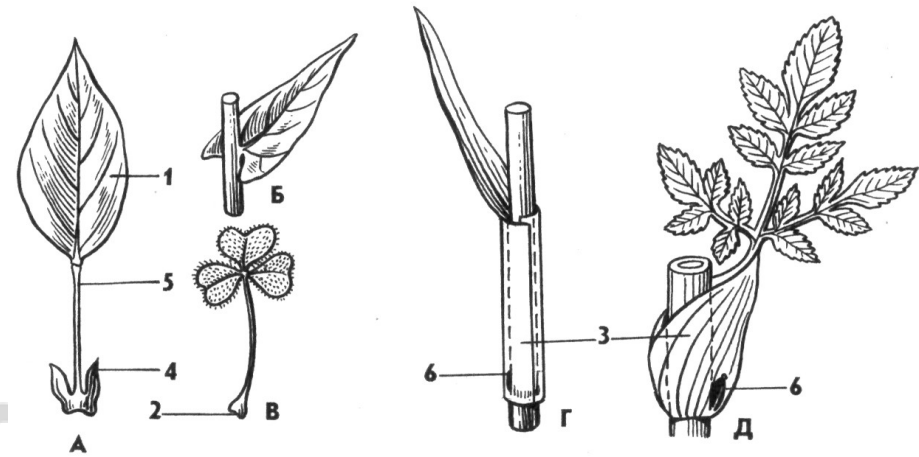
5. For the leaves of most monocots the typical veining is ...

6. The form of the leaf plate is defined by ...



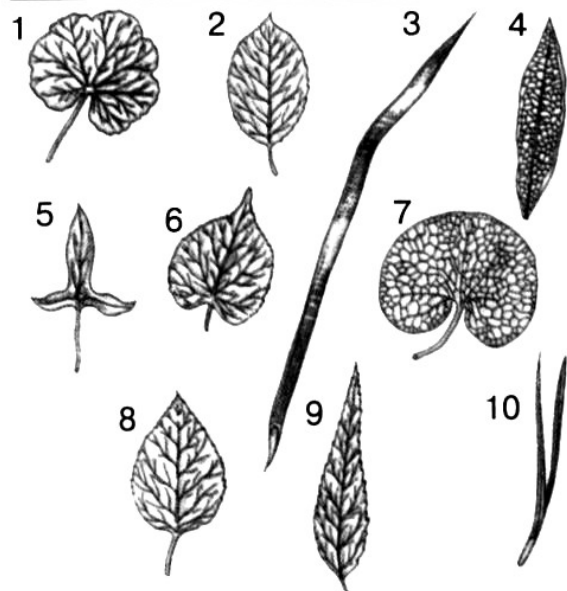
**PRACTICAL WORK**

Task 1. Make notation to the picture



Pic. 1. Parts of the leaf and methods of attachment to the stem:

- A – 1 –
- Б – 2 –
- В – 3 –
- Г – 4 –
- Д – 5 –
- 6 –



**Task 2. Make the description of the morphological diagnostic characteristics of the plant on herbarium specimens according to the scheme.**

*Pic. 2. Describe the form of the leaf blades and venation:*

- 1 –
- 2 –
- 3 –
- 4 –
- 5 –
- 6 –
- 7 –
- 8 –
- 9 –
- 10 –

**Teacher's signature**

Practice № 8. Topic: **STRUCTURE OF GENERATIVE ORGANS OF PLANTS  
(FLOWER, INFLORESCENCES)**

«\_\_\_\_\_» \_\_\_\_\_ 201\_\_ year

**Purpose of the practice:** to study morphological peculiarities of the structure of plants.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"><li>1. Theories of flower genesis.</li><li>2. The structure of a flower. Location of the parts of a flower.</li><li>3. Formula and diagram of a flower.</li><li>4. Peculiarities of the structure of inflorescences.</li><li>5. Classification of inflorescences.</li></ol>	<ol style="list-style-type: none"><li>5. <b>Perianth</b> –</li><li>6. <b>Calyx</b> –</li><li>7. <b>Petals</b> –</li></ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"><li>1. <b>Flower</b> –</li><li>2. <b>Receptacle</b> –</li><li>3. <b>Androecium</b> –</li><li>4. <b>Gynoecium</b> – – <b>monocarpous</b> – – <b>apocarpous</b> – – <b>coenocarpous</b> – – <i>paracarpous</i> –</li></ol>	<ol style="list-style-type: none"><li>8. <b>Simple perianth</b> –</li><li>9. <b>Actinomorphic flower</b> –</li><li>10. <b>Zygomorphic flower</b> –</li><li>11. <b>Asymmetric flower</b> –</li><li>12. <b>Hermaphrodite flower</b> –</li><li>13. <b>Inflorescences</b> –</li></ol>



– *syncarpous* –

– *lysicarpous* –

14. **Monochasial cyme** –

15. **Dichasial cyme** –

16. **Pleiochasial cyme** –

#### TESTS FOR SELF-CONTROL

1. **Flower contains:** a) axial rod; b) receptacle, perianth; c) pistil and axial rod; d) stamens and sporangium; e) sporangiophore and sporangium.

2. **Modified leaves form:** a) pedicel; b) receptacle; c) perianth; d) pistil and pedicel; e) no correct answer.

3. **Modified stem form:** a) perianth; b) receptacle; c) ovary; d) pistil; e) stamens.

4. **The sporophyte of angiosperms is a:** a) vegetative plant; b) stigma; c) anther; d) pollen grain; e) flower.

5. **If the parts of the flower are arranged in concentric circles, the flower is called:** a) cyclic; b) acyclic; c) hemicyclic; d) concentric; e) zygomorphic.

6. **If gynoecium consists of several carpels that are not fused to each other and form a lot of pistils, it is called:** a) monocarpous;

9. **Biological meaning of inflorescences:** a) small flowers in inflorescences are more visible for insects; b) inflorescences are colored brighter than single flowers; c) water pollinates a group of flowers; d) flowers in inflorescences secrete nectar; e) flowers in inflorescences emit a fragrance.

#### OPEN TESTS

##### Fill in the gaps:

1. Reduced stamen (without anthers), are called ...
2. The inner part of receptacle contains gynoecium, i.e. a complex of ... that form pistil.
3. Flowers with no ... are called sessile.
4. The flower in the picture has ... gynoecium.
5. Projection of a flower on a plane is ...
6. The description of the flower with the help of letters and numbers is ...
7. Staminodes are modified ...



b) apocarpous; c) coenocarpous; d) pseudomonocarpous; e) syncarpous.

7. Flower at the picture has: a) superior ovary;

b) inferior ovary, c) semi-inferior.

8. The formula of bisexual flower with simple

perianth: a)  $\text{Ca}_5\text{Co}_5\text{A}_5\text{G}_{(5)}$ ; b)  $\text{P}_5\text{A}_\infty\text{G}_\infty$ ;

c)  $\text{P}_4\text{A}_4\text{G}_0$ ; d)  $\text{P}_{(4)}\text{A}_0\text{G}_{(2)}$ ; e)  $\text{Ca}_{(4)}\text{Co}_{(4)}\text{A}_{4+4}\text{G}_{(4)}$



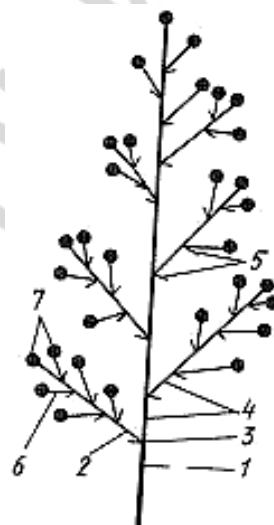
### PRACTICAL WORK

Task 1. Study the pictures and make indications.

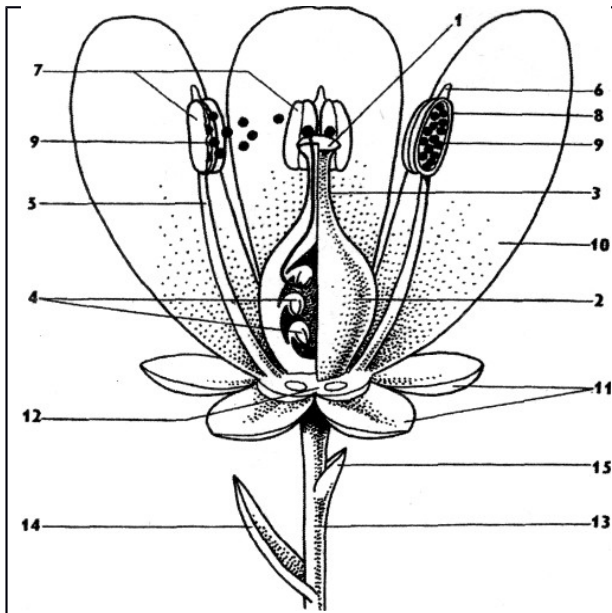
*Pic. 1.* The structure of a flower:

- 1 –
- 2 –
- 3 –
- 4 –
- 5 –
- 6 –
- 7 –
- 8 –
- 9 –
- 10 –
- 11 –
- 12 –
- 13 –
- 14 –
- 15 –

Task 2. Study the structure of the inflorescences. Make indications.

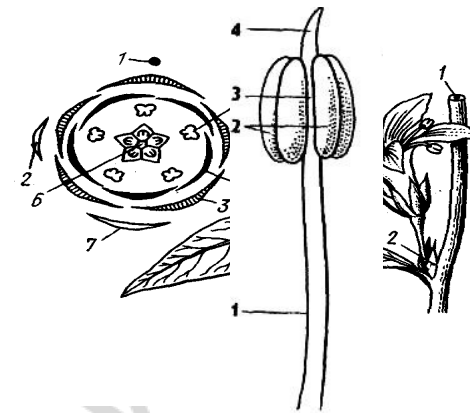


- bracts,
- pedicels,
- lateral axis,
- internodes,
- main axis,
- flowers,
- nodes.



*Pic. 2. The structure of a stamen:*

- 1 –
- 2 –
- 3 –
- 4 –



**Task 3. Study the diagram of the flower. Make indications and flower's formula.**

- 1 –
- 2 –
- 3 –
- 4 –
- 5 –
- 6 –
- 7 –

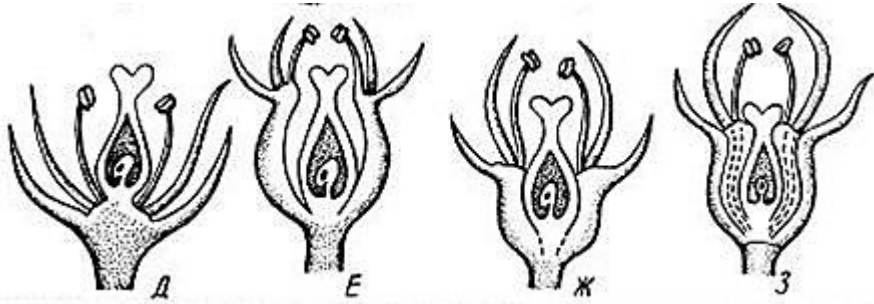
**Task 4. Study the positions of ovary. Make indications.**

– inferior ovary, epigynous perianth,

**Task 6. Study the simpodial inflorescences.**

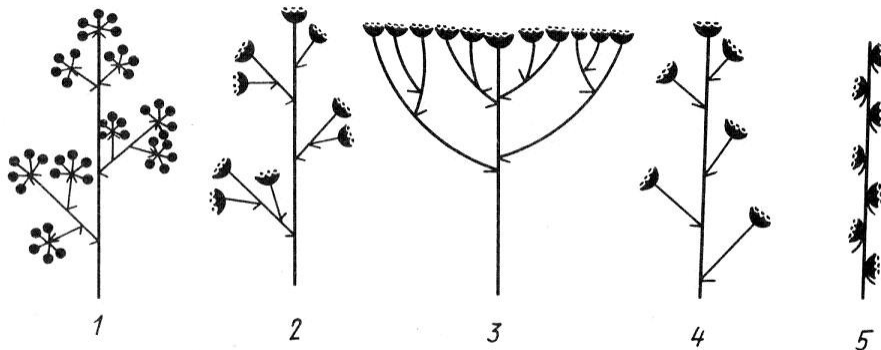
– single cyme;

- single ovary of monokarpous gynoecium;
- superior ovary, hypanthium is shown;
- superior ovary, epigynous perianth;

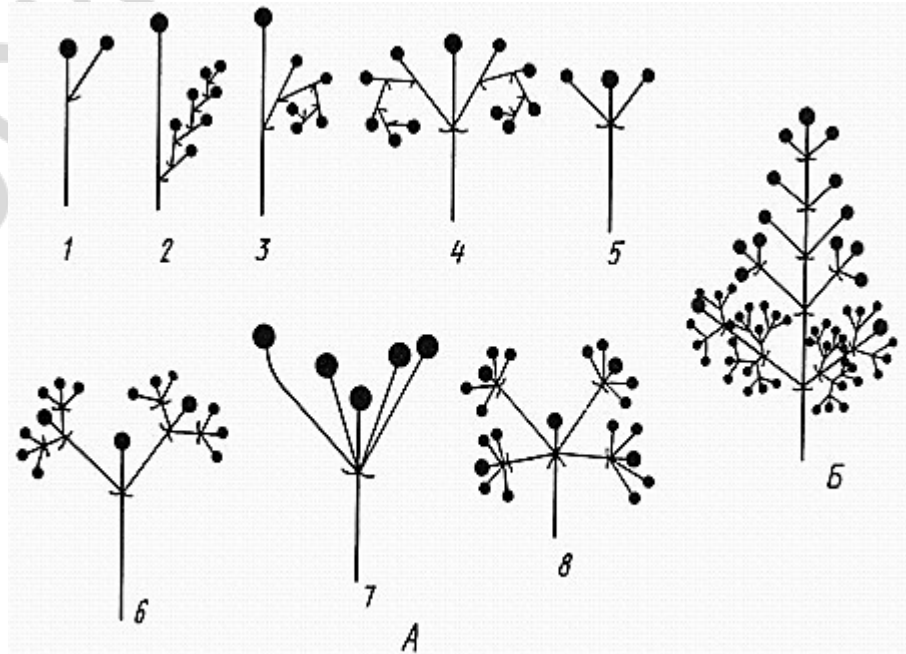


**Task 5. Study the types of the inflorescences.**

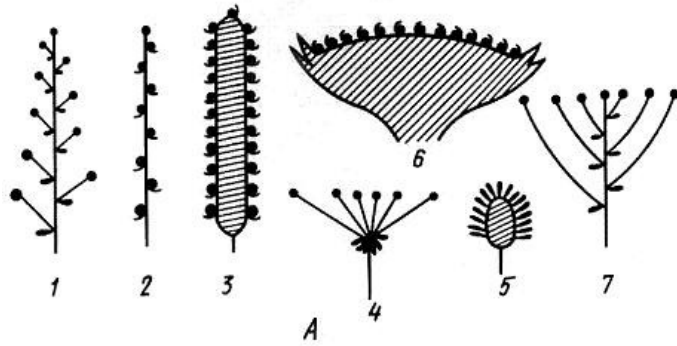
- corymb of baskets,
- raceme of baskets,
- spike of baskets.
- panicle of umbels,
- panicle of baskets.



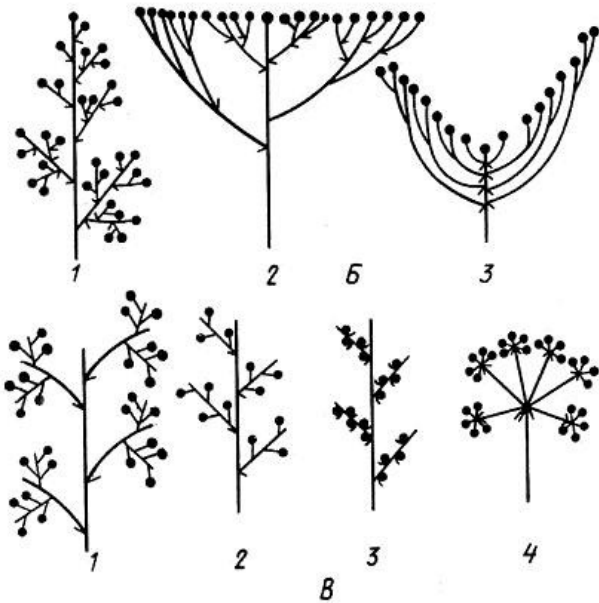
- bend;
- coil;
- dichasial cyme;
- dichasium;
- triple dichasium;
- pleiochasial cyme;
- pleiochasium;
- double pleiochasium;
- thyrsus;
- cymous;
- monochasial cyme;
- double coil.



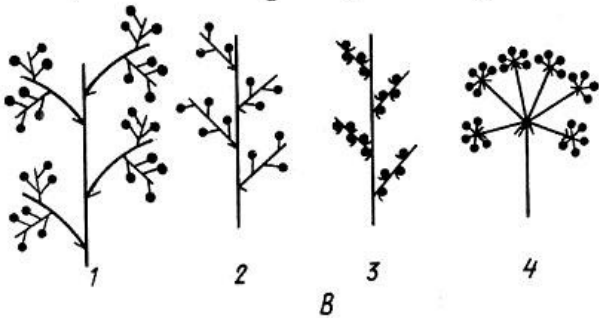
**Task 7. Study the botrious inflorescences.**



A – Simple inflorescences:  
 – raceme  
 – spike  
 – cob  
 – umbell  
 – basket  
 – capitulum  
 – small shield



B – Compound inflorescences.  
 Whisk and its derivatives:  
 – whisk,  
 – compound corymb,  
 – antella;



C – Compound botrious.  
 compound brush and its derivatives:  
 – triple raceme,  
 – double raceme,

**Task 8. Study the structure of the flower.**

- Study the flowers, pay attention on size, form, interrelation of calyx lobes and petals, type of a perianth.
- Describe the flowers according to the scheme; make formula and diagram of the flowers.

Teacher's signature

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>- double spike,</li><li>- double umbel.</li></ul> |  |
|---|--|

Репозиторий БГМУ

**Purpose of the practice:** to study morphological characteristics and structural features of seeds and fruits.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. Micro- and megasporogenesis of angiosperms. The development of male and female gametophyte.</li> <li>2. The essence of double fertilization.</li> <li>3. The origin and development of seeds and fruits.</li> <li>4. The classification of seeds.</li> <li>5. The classification of fruits.</li> </ol>	<ol style="list-style-type: none"> <li>8. Antipodes –</li> <li>9. Chalaza –</li> <li>10. Double fertilization –</li> </ol>
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. Exine –</li> <li>2. Intine –</li> <li>3. Tapetum –</li> <li>4. Nucellus –</li> <li>5. Micropyle –</li> <li>6. Endosperm –</li> <li>7. Synergids –</li> </ol>	<ol style="list-style-type: none"> <li>11. Apomixis –</li> <li>12. Amphimixis –</li> <li>13. Apocarps –</li> <li>14. Monocarps –</li> <li>15. Coenocarps –</li> <li>16. Pseudomonocarps –</li> <li>17. Paracarps –</li> </ol>

### TESTS FOR SELF-CONTROL

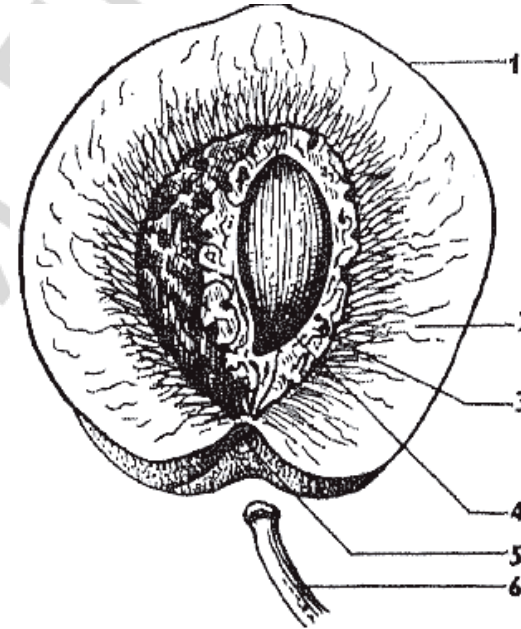
- 1. The essence of the flowering plants' double fertilization:** a) fusion of the ovum and central cells; b) transfer of twice the amount of pollen; c) fusion one of the sperms with the ovum, fusion of the other with the central cell of the embryo sac; d) fusion of the sperm and vegetative cell; e) formation of pollen
- 2. The true fruits develop from:** a) the anthers; b) ovary; c) the receptacle; d) the base of the sepals; e) the base of the petals; f) pistil.
- 3. False fruits develop on overgrowth of:** a) plumule; b) peaks of stamens; c) bases of sepals and petals; d) peduncle; e) shoot.
- 4. The fruit berry is different from drupes because it is:** a) polyspermous; b) juicy; c) apocarp; d) has no woody inner layer of the pericarp; e) indehiscent with a thin pericarp; f) coenocarp.
- 5. Perisperm is formed:** a) from the central triploid cell; b) from synergids cells; c) from antipode cells; d) from zygotes; e) from the nucellus cells.
- 6. The fruit of fennel is called:** a) apple; b) fraga; c) cremocarp; d) berry; e) achene.
- 7. What fruit does strawberry have?** a) polynut; b) polystone-fruit; c) berry; d) monophyllos; e) hesperides; f) fraga.
- 8. Seeds are classified according to:** a) the number of cotyledons; b) the place of deposition of nutrient substances; c) exocarp structure; d) chemical composition; e) the structure of the seed coat.

### FILL IN THE GAPS

1. Male gametophyte of flowering plants is ...
2. The fruit in which the pericarp is formed from the walls of the ovary is called ...
3. Double fertilization was discovered by ... in 1898.
4. ... fruit develops from the flower with inferior ovary.
5. The female gametophyte in the flower is ...
6. The main classification of fruits is based on ...

### PRACTICAL WORK







**Task 1. Study the structure of the drupelet on the example of a peach.**




- 1 –
- 2 –
- 3 –
- 4 –
- 5 –
- 6 –

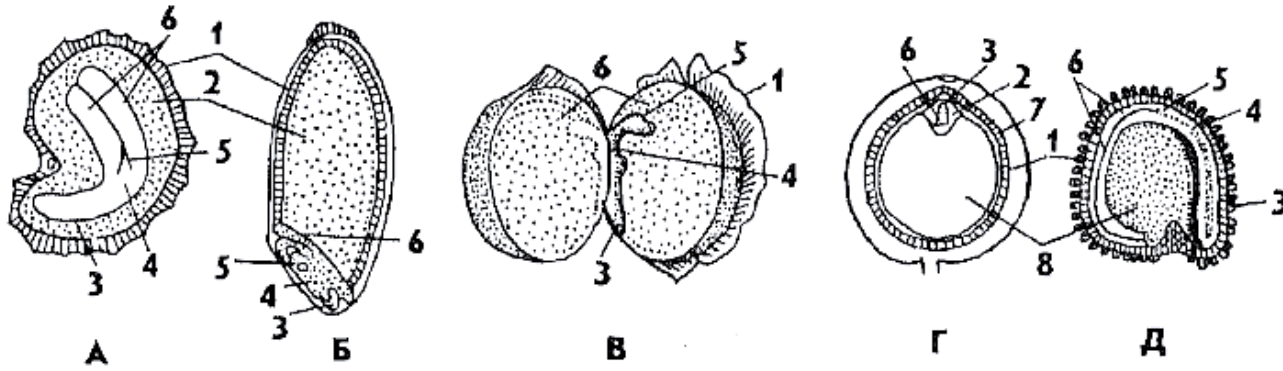


**Task 2. Carry out a morphological analysis of the collection of fruits, determine which group they belong, give names, sketch.**

1. Buckweat		7. Greek walnut	
2. Marsh marigold		8. Meadow buttercup	
3. Kidney bean		9. Fennel	
4. Black henbane		10. Wild strawberry	
5. Barley		11. Dill	
6. Wheat		12. Pedunculate oak	

13. Raspberry common		19.	
14. Common pear		20.	
15. Field ash		21.	
16.		22.	
17.		23.	
18.		24.	

Task 3. Study the structure of the seeds. Make designations.



COCKWEED

- 1 -
- 2 -
- 3 -
- 4 -
- 5 -
- 6 -

WHEAT

- 1 -
- 2 -
- 3 -
- 4 -
- 5 -
- 6 -

PEAS

- 1 -
- 2 -
- 3 -
- 4 -
- 5 -
- 6 -

POPPY HYPNOTIC

- 1 -
- 2 -
- 3 -
- 4 -
- 5 -
- 6 -
- 7 -
- 8 -

PEPPER

- 1 -
- 2 -
- 3 -
- 4 -
- 5 -
- 6 -
- 7 -
- 8 -

Teacher's signature

**Aim:** to identify the level of knowledge of the material.

<b>TEST QUESTIONS</b>	
<ol style="list-style-type: none"> <li>1. Features of the structure of algae.</li> <li>2. Classification of algae. The main representatives of the classes.</li> <li>3. Features of the structure, reproduction of cyanobacteria.</li> <li>4. Features of the structure and reproduction of green, diatoms, brown and red algae.</li> <li>5. Environmental groups of algae.</li> <li>6. The biological and economic value of algae.</li> <li>7. Features of biology of fungi.</li> <li>8. Distinguishing features of Chytridiomycota (Chytridiomycetes), Zygomycota (Zygomycetes), Ascomycota (Ascomycetes), Basidiomycota (Basidiomycetes) and Deuteromycota (Deuteromycetes).</li> <li>9. The role of fungi in nature, medicine and agriculture.</li> <li>10. Peculiarities of the structure of lichens. Their meaning.</li> <li>11. Features of the structure and position of Bryophyte in the system of the plant world's flora's evolution.</li> <li>12. Features of the structure and the development cycle of moss Polytrichum commune.</li> <li>13. Biological features, the value of sphagnidae.</li> <li>14. Features of the structure and development cycle representatives of the lycopodiophyta.</li> </ol>	<ol style="list-style-type: none"> <li>15. The value of mosses and lycopodiophyta in medicine, nature, the national economy.</li> <li>16. Features of the structure and the development cycle of main representatives of Equisetophyta.</li> <li>17. Features of the structure and the development cycle of main representatives of Polypodoiphyta.</li> <li>18. The value of Equisetophyta and Polypodoiphyta in medicine, nature, the national economy.</li> <li>19. Features of the development cycle of gymnosperms (on the example of Scots pine).</li> <li>20. Progressive signs of gymnosperms in the structure and reproduction in comparison with spore plants.</li> <li>21. The structure of the strobili, seeds of the gymnosperms.</li> <li>22. Classification of the gymnosperms.</li> <li>23. The value of gymnosperms in medicine, nature, national economy.</li> <li>24. The subject of plant morphology.</li> <li>25. Vegetativnye and generative plants organs.</li> <li>26. The structure of the root, its functions.</li> <li>27. Types of roots origin.</li> <li>28. The root system.</li> <li>29. Roots' metamorphosis.</li> </ol>

30. Features of stem morphology, its functions.
31. The origin of the stem.
32. Types of stem branching.
33. Shoots' modifications.
34. The origin of the leaf.
35. The structure of the leaf.
36. Simple and compound leaves, classification, examples.
37. Types of a phyllotaxy, metamorphosis of the leaf.
38. The leaf blade — the form, the character of edge, venation, the type of dissection of blade.
39. Theories of flower genesis.
40. The structure of a flower. Location of the parts of a flower.
41. Formula and diagram of a flower.
42. Features of the inflorescences structure.
43. Classification of inflorescences.
44. Micro- and megasporogenesis of angiosperms. The development of male and female gametophyte.
45. The essence of double fertilization.
46. The origin and development of seeds and fruits.
47. The classification of seeds.
48. The classification of fruits.

**Teacher's signature**

**Purpose of the practice:** to learn how to determine the specific membership of plants, using herbarium fresh vegetal material, preserved in alcohol.

<b>CONTROL QUESTIONS</b>	<b>PRACTICAL WORK</b>	
<ol style="list-style-type: none"> <li>1. The origin of Flowering plants. The diagnostic characters of the division.</li> <li>2. The system of A. L. Takhtadzhan.</li> <li>3. Phylogenetic series. The main directions of evolutionary changes of Angiosperms.</li> <li>4. Main subclasses of Dicotyledones.</li> <li>5. Orders of subclasses Magnoliidae, Ranunculidae</li> <li>6. The character of orders Magnoliales, Laurales, Ranales, Papaverales and families, belonging to them.</li> </ol>	<b>Task 1. Write Latin names, family and order.</b>	
<p style="text-align: center;"><b>BASIC TERMS AND CONCEPTS</b></p> <ol style="list-style-type: none"> <li>1. Evolutionary series –</li>   <li>2. Taxonomical categories –</li> </ol>	<i>Caltha palustris L.</i>	
	<i>Ranunculus acris L.</i>	
	<i>Delphinium elatum L.</i>	
	<i>Berberis vulgaris L.</i>	
	<i>Papaver somniferum L.</i>	
	<i>Chelidonium majus L.</i>	
	<i>Paeonia anomala L.</i>	
<i><u>Aconitum napellus L.</u></i>		

### PLAN OF THE MORPHOLOGICAL DESCRIPTION OF FLOWERING PLANT

1. LIFE FORMS OF PLANT
2. ROOT: type of the root in origin. Type of the root system.
3. ROOTSTOCK: branching, the size of internodes, thickness, growth trend.
4. BULB: shape, size, location.
5. TUBER: shape, size.
6. STEM: location in space, transverse incision, type and features of branching, pubescence.
7. LEAF: leaf complexity, the degree of dissection, shape of the leaf, shape of the leaf edge, venation, pubescence and character of hair.
8. LEAF'S VENATION: method of attaching leaves to the stem, availability and shape of stipules. Modifications of the leaf.
9. FLOWER: color, size, single or in inflorescence (name the type), write the formula of the flower and draw the diagram.
10. FRUIT: type of the fruit, number of nests and seeds, method of dehiscence, feature of the surface.
11. SEED: what part of the seed has reserve nutrients, shape, size, feature of the surface.

### WORKING WITH DETERMINANTS.

To determine a plant — means to define, what family, genus and species the plant that is examined by us belongs to.

Determinants have so-called «dichotomous» tables for this purpose. Each table consists of gradual stages which are designated by serial numbers from the left side of the table. Each stage in its turn is divided into two parts: thesis and antithesis. Thesis is designated by serial number (number of the stage or «+»), antithesis – number 0 or «-».

The most characteristic features are shown in thesis and antithesis. Antithesis always contains features that are opposites to that ones that are given in thesis.

Firstly, it is necessary to determine which class does this plant belongs to, then using the table for determining families find the appropriate one.

The next step — determining the genus within the family, and then using the table for determining species of the genus identify which species does the plant example belongs to.

**Task 2. Make a morphological description of individual plants set.  
Draw the appearance of the plant, reflecting its structural features.  
Identify species belonging.**

**Teacher's signature**



**Purpose of the practice:** to study to identify systematic affiliation of plants using the herbarium, preserved in alcohol and fresh plant material.

<b>CONTROL QUESTIONS</b>			
1. Characteristic of subclass Caryophyllidae, orders of the subclass. 2. Orders Caryophyllales, Polygonales, its systematic variety. 3. Characteristic of Caryophyllaceae family. 4. Characteristic of Chenopodiaceae family 5. Characteristic of Polygonaceae family.		<i>Rumex confertus Willd</i>	
<b>PRACTICAL WORK</b>			
<b>Task 1. Write the Latin names and give full taxonomic position of the plants.</b>		<i>Rheum palmatum L.</i>	
<i>Polygonum aviculare L.</i>		<i>Saponaria officinalis L.</i>	
<i>Polygonum hydropiper L.</i>		<i>Agrostemma githago L.</i>	
<i>Polygonum bistorta L.</i>		<i>Chenopodium album L.</i>	
<i>Polygonum persicaria L.</i>			

**Task 2. Make a comparative description of morphological signs of these plants in the form of a table.**

Name of a plant	Signs					
	Living forme	Underground organs	Stems	Leaf	Flower	Fruit
<i>Polygonum aviculare L.</i>						
<i>Polygonum hydropiper L.</i>						
<i>Polygonum bistorta L.</i>						
<i>Polygonum persicaria L.</i>						

**Task 3. Make a morphological description of plants from individual herbarium set. Draw the appearance of plants, reflecting the features of the structure. Determine species.**

**Teacher's signature**

**Purpose of the practice:** to learn to determine the species of plants using herbarium preserved in alcohol and fresh floral material.

<b>CONTROL QUESTIONS</b>					
1. Name the orders of the subclass Hamamelididae. 2. Characteristic of the subclasses Fagales, Betulales. 3. Characteristic of the families: Fagaceae, Betulaceae. 4. List the orders of the subclass Dilleniidae. 5. Characteristic of the orders: Malvales, Euphorbiales, Salicales, Ericales, Primulales, Cucurbitales, Theales. 6. Characteristic of the families: Malvaceae, Euphorbiaceae, Salicaceae, Tiliaceae, Ericaceae, Vacciniaceae, Violaceae, Cucurbitaceae, Primulaceae, Hypericaceae.		<i>Alnus glutinosa (L.) Gaertn.</i>			
		<i>Viola tricolor L.</i>			
		<i>Viola arvensis Murray</i>			
		<i>Ledum palustre L.</i>			
		<b>PRACTICAL WORK</b>			
		<b>Task 1. Write the Latin names and give the full taxonomic position of the plants.</b>		<i>Arctostaphylos uva-ursi (L.) Spreng.</i>	
<i>Betula pendula Roth</i>		<i>Calluna vulgaris (L.) Hull</i>			
<i>Quercus robur L.</i>		<i>Vaccinium vitis-idaea L.</i>			
<i>Alnus incana (L.) Moench</i>		<i>Vaccinium myrtillus L.,</i>			
<i>Hypericum perforatum L.</i>		<i>Oxycoccus palustris Pers.</i>			
<i>Salix acutifolia Willd.</i>		<i>Althaea officinalis L.</i>			

**Task 2. Make a comparative description of the morphological signs of the following plants in the table.**

	<b>Life form</b>	<b>Underground organs</b>	<b>Stems</b>	<b>Leaf</b>	<b>Flower</b>	<b>Fruit</b>
<i>Vaccinium myrtillus L.</i>						
<i>Vaccinium vitis-idaea L.</i>						
<i>Arctostaphylos uva-ursi (L.) Spreng.</i>						

**Task 3. Make the morphological description of the plant from the individual set. Draw the plant reflecting the specific features of the structure. Determine the species.**

**Teacher's signature**

**Purpose of the practice:** to learn to determine the accessory of the species of the plants by using herbarium, preserved in alcohol, and fresh vegetable material.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <ol style="list-style-type: none"> <li>1. To name the orders of the subclasses Dilleniidae, Rosidae.</li> <li>2. Characteristic of the orders Urticales, Capparales, Rosales, Saxifragales, Rhamnales.</li> <li>3. Characteristic of the families: Urticaceae, Brassicaceae, Crassulaceae, Saxifragaceae, Grossulariaceae, Rosaceae, Rhamnaceae.</li> <li>4. Characteristic of the subfamilies: Spiraeoideae, Rosoideae, Maloideae, Prunoideae.</li> </ol>	<p><b>Task 2. Write down Latin names and give full systematic position of the plants.</b></p>
<p style="text-align: center;"><b>PRACTICAL WORK</b></p> <p><b>Task 1. Make the morphological description of the plant from individual herbarium collection. Make sketches of appearance of the plant representing structure features. Determine species accessory.</b></p>	<p><i>Brassica juncea (L.) Czern.</i></p>
	<p><i>Capsella bursa-pastoris (L.) Medik.</i></p>
	<p><i>Erysimum cheiranthoides L.</i></p>
	<p><i>Urtica dioica L.</i></p>
	<p><i>Bergenia crassifolia (L.) Fritsch</i></p>
	<p><i>Ribes nigrum L.</i></p>
<p><i>Rubus idaeus L.</i></p>	

<i>Frangula alnus Mill.</i>		<i>Rhodiola rosea L.</i>	
<i>Humulus lupulus L.</i>		<i>Rhamnus cathartica L.</i>	
<i>Fragaria vesca L.</i>		<i>Potentilla erecta (L.) Raeusch.</i>	
<i>Sanguisorba officinalis L.</i>		<i>Potentilla anserina L.</i>	
<i>Ficus carica L.</i>		<i>Potentilla argentea L.</i>	
<i>Rosa majalis Herrm.</i>		<i>Potentilla alba L.</i>	
<i>Sorbus aucuparia L.</i>		<i>Crataegus oxyacantha L.</i>	
<i>Crataegus sanguinea Pall.</i>		<i>Rosa cinnamomea L.</i>	
<i>Prunus padus L.</i>		<i>Alchemilla vulgaris L.</i>	

**Task 3. Make up comparative characteristics of morphological features of indicated plants in a form of a table.**

Name of the plant	Features					
	Life form	Underground organs	Stems	Leaf	Flower	Fruit
<i>Potentilla erecta</i> (L.) Raeusch.						
<i>Potentilla alba</i> L.						
<i>Potentilla anserina</i> L.						
<i>Frangula alnus</i> Mill.						
<i>Rhamnus cathartica</i> L.						

**Teacher's signature**



**Purpose of the practice:** to learn to determine the species of plants using herbarium preserved in alcohol and fresh floral material.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <p>1. List the orders of the subclass Rosidae.            2. Characteristic of the orders: Fabales, Araliales, Dipsacales.            3. Characteristic of the families Araliaceae, Apiaceae, Caesalpiniaceae, Mimosaceae, Fabaceae, Caprifoliaceae, Valerianaceae.</p>	<p><b>Task 2. Write the Latin names and give full taxonomic position of the plants.</b></p>	
<p style="text-align: center;"><b>PRACTICAL WORK</b></p> <p><b>Task 1. Make the morphological description of the plant from the individual set. Draw the plant reflecting the specific features of the structure. Determine the species.</b></p>	<p><i>Panax ginseng C. A. Mey</i></p>	
	<p><i>Eleutherococcus senticosus (Rupr. &amp; Maxim.) Maxim.</i></p>	
	<p><i>Foeniculum vulgare Mill.</i></p>	
	<p><i>Coriandrum sativum L.</i></p>	
	<p><i>Daucus carota L.</i></p>	
	<p><i>Foeniculum vulgare Mill.</i></p>	
	<p><i>Cicuta virosa L.</i></p>	

<i>Carum carvi L.</i>		<i>Melilotus officinalis (L.)</i>	
<i>Valeriana officinalis L.</i>		<i>Melilotus albus Medik.</i>	
<i>Conium maculatum L.</i>		<i>Viburnum opulus L.</i>	
<i>Pisum sativum L.</i>		<i>Sambucus nigra L.</i>	
<i>Ononis spinosa L.</i>		<i>Astragalus dasyanthus Pall.</i>	
<i>Glycyrrhiza glabra L.</i>		<i>Oplopanax elatus (Nakai) Nakai</i>	
<i>Anisum vulgare Gaertn.</i>		<i>Aralia mandshurica Rupr. et Maxim.</i>	

**Task 3. Make a comparative description of the morphological signs of the following plants.**

Name of Plants	Features					
	Life form	Underground organs	Stems	Leaf	Flower	Fruit
<i>Carum carvi L.</i>						
<i>Foeniculum vulgare Mill.</i>						
<i>Conium maculatum L.</i>						

**Teacher's signature**

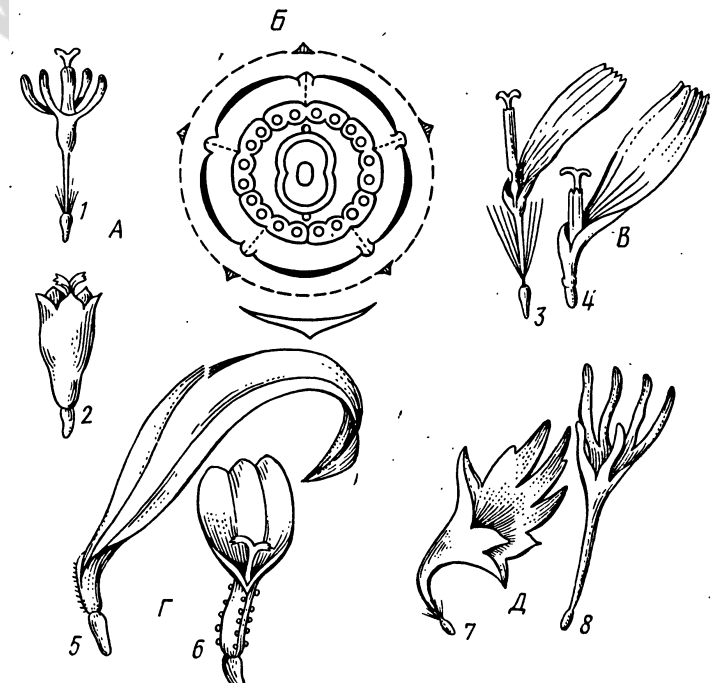
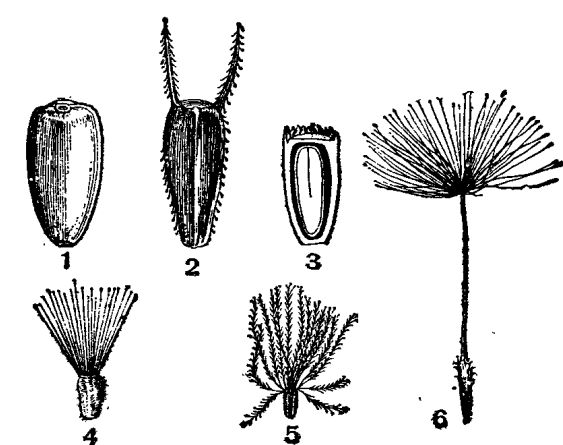
**Purpose of the practice:** to learn to determine the species of plants using herbarium, preserved in alcohol and fresh floral material.

<b>CONTROL QUESTIONS</b>			
1. List the orders of the subclass Lamiidae. 2. Characteristic of the orders Gentianales, Solanales, Polemoniales, Boraginales, Scrophulariales, Convolvulales. 3. Characteristic of the families: Rubiaceae, Gentianaceae, Menyanthaceae, Solanaceae, Polemoniaceae, Boraginaceae, Scrophulariaceae, Plantaginaceae, Convolvulaceae.		<i>Polemonium caeruleum L.</i>	
		<i>Atropa belladonna L.</i>	
		<i>Symphytum officinale L.</i>	
<b>PRACTICAL WORK</b>			
<b>Task 1. Write the Latin names and give full taxonomic position of the plants.</b>		<i>Syringa vulgaris L.</i>	
<i>Plantago major L.</i>		<i>Digitalis purpurea L.</i>	
<i>Plantago lanceolata L.</i>		<i>Centaurium erythraea Rafn</i>	
<i>Plantago arenaria Waldst. &amp; Kit.</i>		<i>Menyanthes trifoliata L.</i>	
<i>Datura stramonium L.</i>		<i>Rubia tinctorum L.</i>	
<i>Hyoscyamus niger L.</i>		<i>Cynoglossum officinale L.</i>	

**Task 2. Make the morphological description of the plants from the individual set. Draw the plant reflecting the specific features of the structure. Determine the species.**

**Teacher's signature**

**The purpose of the practice:** to study to determine the accessory of the species of the plants by using herbarium, preserved in alcohol, and fresh vegetable material.

<b>CONTROL QUESTIONS</b>	<b>Task 2. Study structure of flowers of the composite family.</b>														
<ol style="list-style-type: none"> <li>1. To name the orders of the subclasses Lamiidae and Asteridae.</li> <li>2. Characteristic of the orders Lamiales, Asterales. To name families.</li> <li>3. Characteristic of the families Lamiaceae and Asteraceae. To name representatives.</li> </ol>	<p><b>Make indications.</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">A –</td> <td>— Helianthus annuus</td> </tr> <tr> <td>B –</td> <td>— Centaurea jacea</td> </tr> <tr> <td>C –</td> <td>— Centaurea cyanus</td> </tr> <tr> <td>D –</td> <td>— Artemisia absinthium</td> </tr> <tr> <td>E –</td> <td>— Taraxacum officinale</td> </tr> <tr> <td></td> <td>— Achillea millefolium</td> </tr> <tr> <td></td> <td>— Cichorium inthybus</td> </tr> </table>	A –	— Helianthus annuus	B –	— Centaurea jacea	C –	— Centaurea cyanus	D –	— Artemisia absinthium	E –	— Taraxacum officinale		— Achillea millefolium		— Cichorium inthybus
A –	— Helianthus annuus														
B –	— Centaurea jacea														
C –	— Centaurea cyanus														
D –	— Artemisia absinthium														
E –	— Taraxacum officinale														
	— Achillea millefolium														
	— Cichorium inthybus														
<b>PRACTICAL WORK</b>															
<p><b>Task 1. Study structure of fruits of the composite family.</b></p> <p><b>Make indications.</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">– Helianthus</td> <td>– Sonchus</td> </tr> <tr> <td>– Bidens</td> <td>– Cichorium</td> </tr> <tr> <td>– Carduus</td> <td>– Taraxacum</td> </tr> </table>	– Helianthus	– Sonchus	– Bidens	– Cichorium	– Carduus	– Taraxacum									
– Helianthus	– Sonchus														
– Bidens	– Cichorium														
– Carduus	– Taraxacum														
															

**Task 3. Make a morphological description of a plant from individual herbarium collection. Make sketches of appearance of the plant representing structure features. Determine species accessory.**

<b>Task 4. Write down Latin names and give full systematic position of the plants.</b>		<i>Tanacetum vulgare L.</i>	
		<i>Taraxacum officinale Webb</i>	
<i>Tussilago farfara L.</i>		<i>Cichorium intybus L.</i>	
<i>Calendula officinalis L.</i>		<i>Rhaponticum carthamoides (Willd.) Iljin</i>	
<i>Arnica montana L.</i>		<i>Centaurea cyanus L.</i>	
<i>Bidens tripartita L.</i>		<i>Thymus serpyllum L.</i>	
<i>Inula helenium L.</i>		<i>Origanum vulgare L.</i>	
<i>Matricaria chamomilla L.</i>		<i>Mentha piperita L.</i>	
<i>Artemisia absinthium L.</i>		<i>Leonurus cardiaca L.</i>	
<i>Gnaphalium uliginosum L.</i>		<i>Leonurus quinquelobatus Gilib.</i>	
<i>Achillea millefolium L.</i>		<i>Salvia officinalis L.</i>	
<i>Helichrysum arenarium (L.) Moench</i>		<i>Scutellaria galericulata L.</i>	

**Teacher's signature**



**The purpose of the practice:** to study to determine the accessory of the species of the plants by using herbarium, preserved in alcohol, and fresh vegetable material.

<b>CONTROL QUESTIONS</b>			
1. To name the orders of the subclasses Alismatidae, Liliidae. 2. Characteristic of the orders Alismatales, Liliales, Asparagales, Orchidales, Amarillidales. To name the families. 3. Characteristic of the families: Alismataceae, Orchidaceae, Alliaceae, Asparagaceae, Convallariaceae, Melanthiaceae, Liliaceae, Iridaceae.		<i>Allium cepa L.</i>	
		<i>Aloe arborescens Mill</i>	
		<i>Colchicum autumnale L.</i>	
<b>PRACTICAL WORK</b>			
<b>Task 1. Write down Latin names and give full systematic position of the plants.</b>			
<i>Platanthera bifolia (L.) Rich</i>		<i>Sagittaria sagittifolia L.</i>	
<i>Orchis militaris L.</i>		<i>Veratrum lobelianum Bernh.</i>	
<i>Iris pallida Lam.</i>		<i>Lilium lancifolium Thunb.</i>	
<i>Convallaria majalis L.</i>		<i>Polygonatum odoratum (Mill.) Druce</i>	
<i>Asparagus officinalis L.</i>		<i>Butomus umbellatus L.</i>	

**Task 2. Make the morphological description of the plant from individual herbarium collection. Make sketches of appearance of the plant representing structure features. Determine species accessory.**

**Task 3. Make up comparative characteristics of morphological features of plants.**

Features	Name of plant	
	<i>Convallaria majalis</i>	<i>Polygonatum officinale</i>
<b>Life form</b>		
<b>Underground organs</b>		
<b>Stems</b>		
<b>Leaf</b>		
<b>Flower</b>		
<b>Fruit</b>		

**Teacher's signature**

**Purpose of the practice:** to learn how to determine the specific membership of plants, using herbarium fresh vegetal material, preserved in alcohol.

<p style="text-align: center;"><b>CONTROL QUESTIONS</b></p> <p>1. Enumerate orders of subclasses Liliidae, Arecidae.                      2. Characteristic of orders Arales, Poales, Cyperales.                      3. Characteristic of families: Araceae, Poaceae, Cyperaceae.</p>	<p><b>Task 2. Fill in the table of comparative characteristics of cereals and sedges.</b></p>		
	<p style="text-align: center;"><b>Feature</b></p>	<p style="text-align: center;"><b>Cereals</b></p>	<p style="text-align: center;"><b>Sedges</b></p>

**PRACTICAL WORK**

**Task 1. Write Latin names and give full systematic position of plants.**

<i>Scirpus lacustris L.</i>	
<i>Hordeum vulgare L.</i>	
<i>Zea mays L.</i>	
<i>Calla palustris L.</i>	
<i>Oryza sativa L.</i>	
<i>Avena sativa L.</i>	
<i>Phleum pratense L.</i>	
<i>Dactylis glomerata L.</i>	
<i>Secale cereale L.</i>	
<i>Acorus calamus L.</i>	
<i>Triticum aestivum L.</i>	

Task 3. Study the structure of inflorescences of cereals. Make notations.



- *Hordeum vulgare*
- *Panicum meliaceum*
- *Oryza sativa*
- *Secale cereale*

- *Triticum vulgare*
- awnless
- awned
- *Triticum durum*
- *Avena sativa*

**Task 4. Make a morphological description of individual plants set. Draw the appearance of the plant, reflecting its structural features. Determine the specific membership of plant.**

**Teacher's signature**