

## **Thematic block Spore plants.**

### **Lesson 3: Divisions Lycopodiophyta, Equisetophyta, Polypodiophyta**

**The purpose of the lesson:** learn the life cycles and morphological features of spore plants. Learn to describe them morphologically and determine their systematic position.

#### **Initial level questions.**

1. Which kingdom and subkingdom do the divisions do the Lycopodiophyta, Equisetophyta, Polypodiophyta?
2. Name the representatives of the Lycopodiophyta, Equisetophyta, Polypodiophyta divisions used in medicine (Russian and Latin names).
3. Make a morphological description of the Lycopodium, Horsetails, Ferns.
4. How does the development cycle of Lycopodiophyta, Equisetophyta, Polypodiophyta change generations (sexual and asexual) and alternation of nuclear phases (haploid and diploid)?

#### **Instructions for work**

**Herbaria:** field horsetail, river horsetail, ostrich, shield-fern etc.

**Micro preparations:** longitudinal section of a strobilus of a Lycopodium, longitudinal section of a strobilus of a horsetail. Saurus of fern, stem of a Lycopodium, longitudinal section through the strobilus of celaginella.

**Tables:** horsetail and sycamore, field horsetail, Lycopodium clavatum, male scutellum.

**Equipment:** microscope, stereoscopic microscope, magnifying glasses, dissecting needles, blades, tweezers, covers and slides, filter paper, distilled water.

#### **Methodology for performing the work**

**Task 1.** Structure of vegetative and generative organs of Lycopodiophyta, using Lycopodium clavatum as an example.

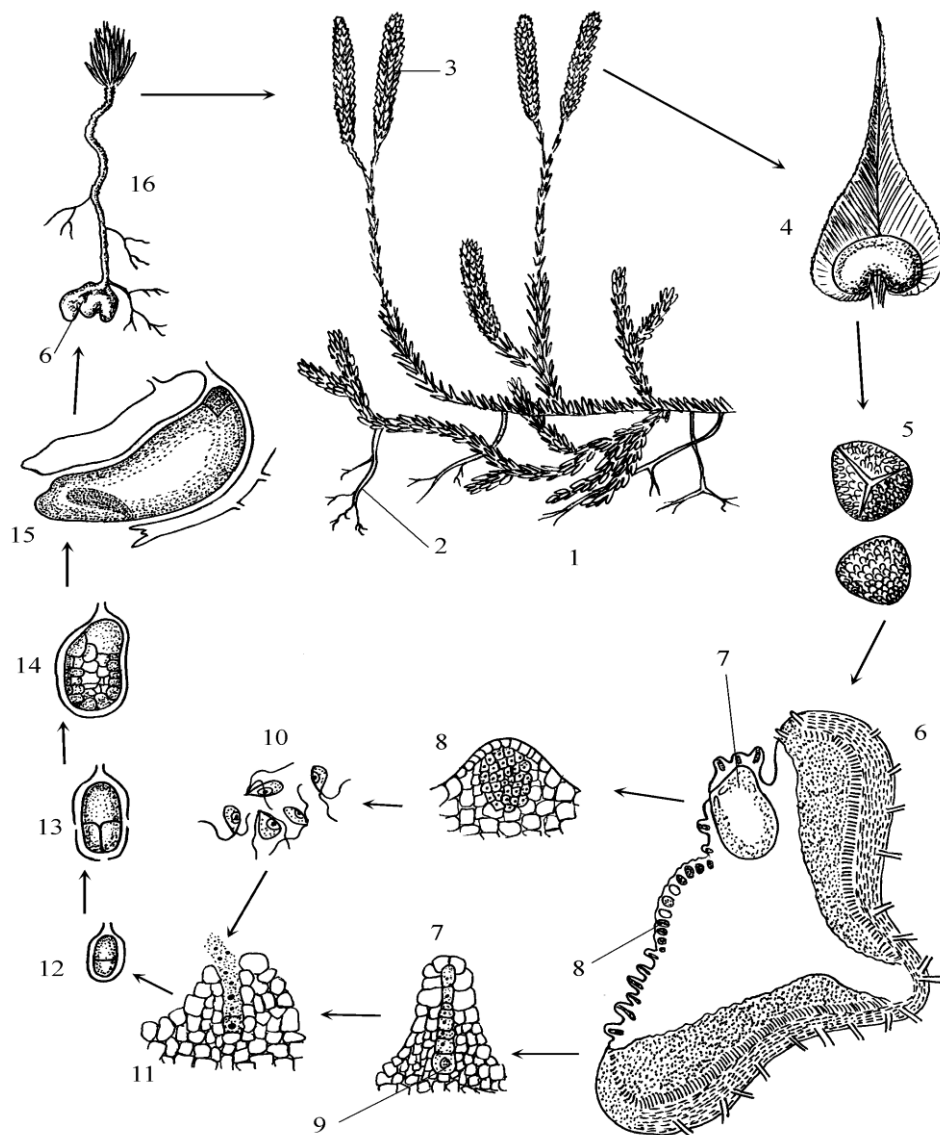
Examine the herbaria of Lycopodium clavatum. Note the specific features of the structure of the leaves and stems. Sketch the appearance of Lycopodium clavatum.

Examine under the microscope the prepared microscope slide "Longitudinal section through the strobilus of Lycopodium". In the field of view, find the sporophyll, to which the sporangium is attached on the upper side with a short stalk. The notch of the sporangium is directed towards the stalk of the spikelet. Sporangium is opened from the inside by a longitudinal slit, from which pyramidal-shaped spores with rounded bases emerge.

Under high magnification, examine the spores in different positions: pyramids with three prominent ribs on top, and triangular-shaped bases. Examine the reticular structure of the outer shell of the spore, the exine.

Sketch the strobilus of a *Lycopodium clavatum* and mark the sporophyll, the sporangia, the spores. Pay attention to the shape and character of the spore surface.

Using the textbook, tables and Fig. 1, study and sketch the life cycle of *Lycopodium clavatum*. In the conclusion, note the peculiarities of the structure of *Lycopodium clavatum*, which distinguish it from other higher spore plants.



**Figure 1. Life cycle of *Lycopodium clavatum* (Orig.).** 1 - sporophyte, 2 - adventitious roots, 3 - strobilus, 4 - sporophyll with sporangium, 5 - spore, 6 - gametophyte, 7 - archaegonium, 8 - anteridium, 9 - ovule, 10 - spermatozoa, 11 - fertilization, 12 - embryo formed from zygote, 13 - embryo development, 16 - young sporophyte.

**Task 2. The structure of vegetative and generative organs of the representatives of the Equisetophyta using the example of the Field Horsetail - *Equisetum arvense*.**

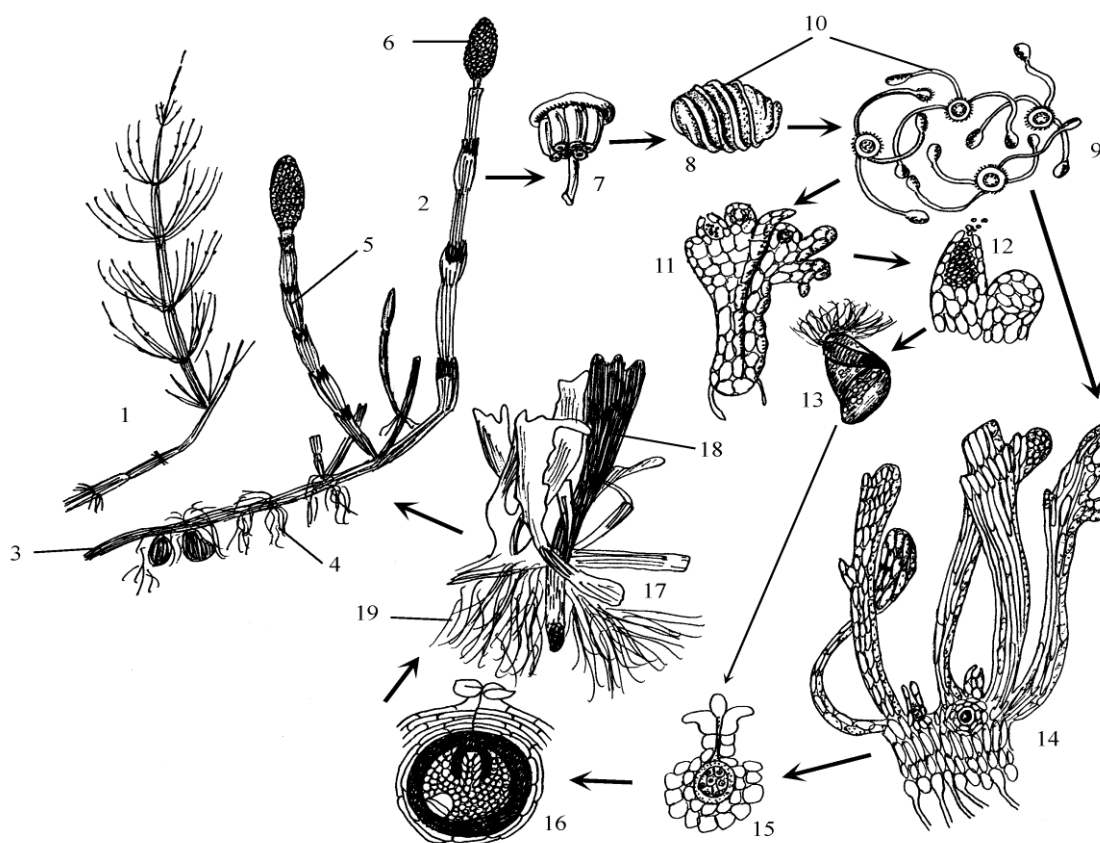
Examine herbaria of *Equisetum arvense*. To note the features of the structure of its vegetative and generative organs. Pay special attention to the fact that strobili are formed on special generative shoots. Consider the general appearance of hexagonal plates tightly pressed to each other and arranged in whorls, they are

sporangiophores (modified sporophylls). Sporangophores take the form of shields, centrally attached by pedicels, radially diverging from the hollow stem. Each scutellum shows 8 to 10 sporangia sacs on its lower side, which open with a slit to the stalk. Sketch the external view of Field Horsetail.

Study the prepared micrograph "Longitudinal section through the strobilus of horsetail" under low magnification of the microscope, examine the sporangiophore with the sporangia. Turn the microscope up to high magnification and view the spores with two spiral ribbons - elateres. The spores are bound together by the elateras in groups. The spores are identical in appearance but produce separate, closely spaced, sexually separated buds. When the spores are arranged in this way, fertilization is possible.

Sketch the strobilus of horsetail and label the strobilus stem, sporophylls, sporangia, and spores.

Using picture 2, the textbook and the tables, study and sketch the life cycle of Horsetail.



**Figure 2. Life cycle of Field Horsetail (Orig.).** 1 - sporophyte, vegetative shoot, 2 - sporophyte, generative shoot, 3 - rhizome, 4 - adventitious roots, 5 - leaves, 6 - strobilus, 7 - sporangiophore, 8 - 9 - spores, 10 - elater, 11 - male gametophyte, 12 - anteridium, 13 - spermatozoon, 14 - female gametophyte, 15 - archaegonium with ovule, 16 - embryo, 17 - young sporophyte formation, 18 - young sporophyte, 19 - rhizoids of gametophyte.

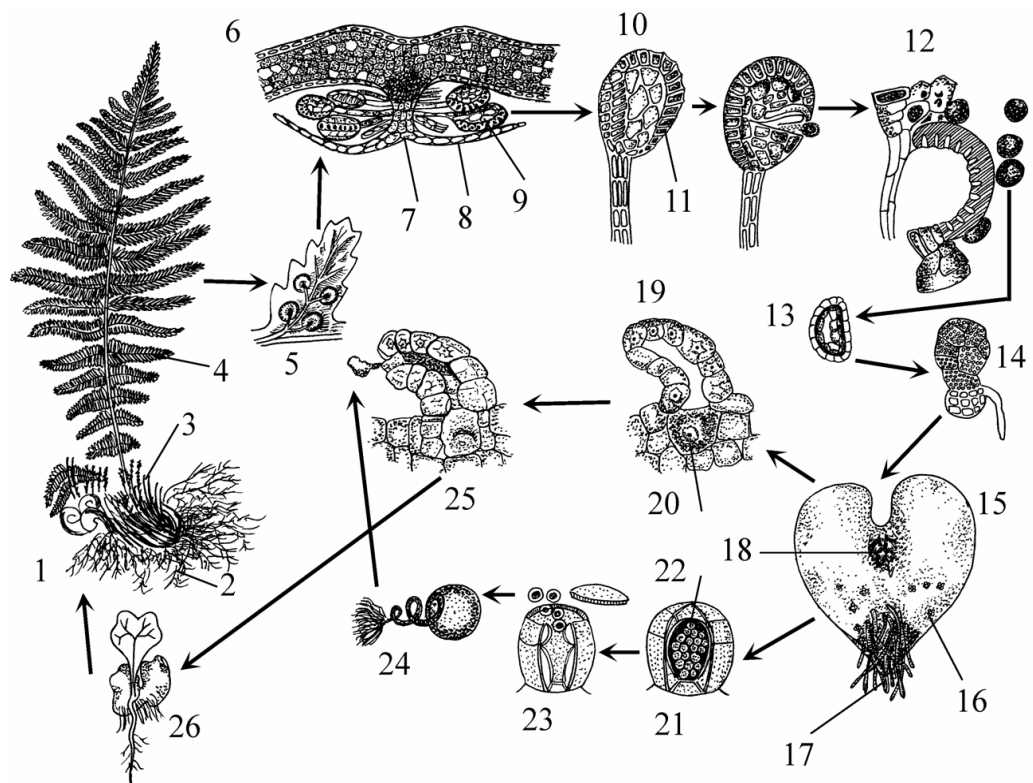
**Task 3. Structure of vegetative and generative organs of ferns using the example of *Dryopteris filix - max.***

Using the tables and the textbook, consider the structure of the vegetative organs of the *Dryopteris filix - max*. Pay special attention to the structure of the leaves of the vai fern. Compare them with the leaves of other higher spore and angiosperm plants. Look for sori on the lower side of the leaves.

Study under low magnification under a microscope the prepared micrograph "A cross section through the fern's sorus". On the underside of the leaf (vaius), you can see the outgrowth of parenchymal tissue (placenta), to which the sporangia peduncle and the capitate peduncle are attached. The sorus is covered by a special scales, the umbrella (indusium), which sits on the stalk. The sporangia can be seen on either side of the stalk. The sporangium is a rounded, flattened formation, provided with special cells along the edge, forming an unenclosed ring. These cells have inner and radial thickenings of the cell membranes, which aid in the sporangium maturation to eject fern spores. The rupture of the sporangium walls is caused by the bending ring. It occurs where the ring does not reach the stalk and its cells have thin walls. The scutellum of the indusium is single-layered, its edges curving towards the leaf lamina, a concave surface is formed under the sorus, trapping some of the spores, which are gradually blown out by the wind.

Sketch the structure of the fern's sori, noting all the details listed.

Using figure 3, the textbook and the charts, study and sketch the life cycle of the fern, the male fern.



**Figure 3. Life cycle of fern as an example of *Dryopteris filix - max* (orig).** 1 - sporophyte, 2 - adventitious roots, 3 - rhizome, 4 - leaf, 5 - leaf segment with sori, 6 - sorus, 7 - placenta, 8 - indusium, 9-10 - sporangium, 11 - ring by means of which sporangium is opened, 12 - opened sporangium, 13 - spore 14 - spore germination, 15 - gametophyte (bud), 16, 21 - anteridia, 17 - rhizoids, 18, 19 - archegonium, 20 - ovule, 22 - spermatogenic tissue, 23 - opened antheridium, 24 - spermatozoon, 25 - embryo formed after fertilization, 26 - young sporophyte.