Class № 1

Topic: Spore-bearing and Gymnosperm Plants of Kyrgyzstan. Classes Pinopsida and Gnetopsida. Rare and Endemic Species: Semyonov Fir, Schrenk Spruce, Junipers (Archa), Intermediate Ephedra, Jointed Ephedra, and others.

Objective of the class: To form in-depth theoretical knowledge regarding the biology, systematics, geographical distribution, resource base, and medicinal significance of higher spore-bearing and gymnosperm plants in the flora of the Kyrgyz Republic, as well as to study the status of rare, endemic, and relict taxa.

Target tasks:

1. To study modern principles of systematics and phylogeny of higher spore-bearing and gymnosperm plants, and their role in the phytocoenoses of the Tien Shan and Pamir-Alai.
2. To investigate the morphological and anatomical features of representatives of the classes Pinopsida and Gnetopsida, and their adaptation to high-altitude and arid climatic conditions.
3. To conduct a detailed analysis of rare, endemic, and relict woody edificators of Kyrgyzstan: Schrenk spruce (*Picea schrenkiana*), Semyonov fir (*Abies semenovii*), and major juniper species (archa).
4. To study the chemical composition, pharmacological properties, and resource base of medicinal plants from the class Gnetopsida (genus *Ephedra*).
5. To review the conservation issues concerning rare plant gene pools of the Kyrgyz Republic included in the Red Data Book, and the rules for rational harvesting of medicinal plant raw materials.

Self-control questions:

1. What is the general characteristics and eco-cenotic role of higher spore-bearing plants (bryophytes, ferns, horsetails, and clubmosses) in the vegetation cover of Kyrgyzstan?
2. Characterize the class Pinopsida: features of life forms, vegetative and generative organs.
3. Provide a detailed botanical and ecological description of the endemic Schrenk spruce and the relict Semyonov fir. What are their differences?
4. The genus Juniper (Archa — *Juniperus*) in Kyrgyzstan: species diversity (hemispherical juniper, Zarafshan juniper, Turkestan juniper), and their environment-forming and anti-erosional roles.
5. Characterize the class Gnetopsida and the family Ephedraceae. Morphological features of Intermediate Ephedra and Jointed Ephedra.
6. Pharmacognostic significance of Ephedra herb (*Herba Ephedrae*): active constituents (ephedrine, pseudoephedrine), pharmacological action, and medical application.

INFORMATIONAL MATERIAL

The vegetation cover of the Kyrgyz Republic is distinguished by exceptional diversity of floristic composition, determined by the complex opographic structure of the territory, sharp contrasts in altitudinal zoning, and the climatic and soil-ground conditions of the Tien Shan and Pamir-Alai. Both ancient autochthonous elements and migrants from neighboring floristic regions participate in the formation of the plant world.

Higher spore-bearing plants (bryophytes, ferns, horsetails, clubmosses) are widely represented in humid spruce forests, subalpine and alpine meadows, and along mountain streams. They play an important role in moisture accumulation, soil formation, and the development of the soil cover. However, the leading environment-forming, water-protecting, and resource-forming role in the forest ecosystems of the republic belongs to gymnosperms, among which coniferous species and xerophytic shrubs dominate.

1. Higher Spore-Bearing Plants in the Flora of Kyrgyzstan

Higher spore-bearing plants are characterized by reproduction and dissemination via spores, with the sporophyte (asexual generation) predominating in the life cycle, while the gametophyte (sexual generation) is reduced.

- **Division Bryophyta (Mosses):** Represented by green and sphagnum mosses, as well as liverworts. They inhabit damp soils, rocks, and tree trunks in spruce forests, contributing to water balance regulation by retaining precipitation.
- **Division Polypodiophyta (Ferns):** Includes perennial herbs with large fronds. In Kyrgyzstan, they grow in shady gorges, along riverbanks, and near springs (shield fern, lady fern, spleenwort).
- **Division Equisetophyta (Horsetails) and Lycopodiophyta (Clubmosses):** Distributed in meadows, fields, and forests (field horsetail, wood horsetail, staghorn clubmoss). Field horsetail is widely used in medical practice as a diuretic and hemostatic agent.

2. Class Pinopsida (Conifers): Forest Formers of the Tien Shan

Coniferous plants are an ancient group of seed plants whose seeds lie openly on cone scales. In the flora of Kyrgyzstan, conifers form unique mountain forests.

- **Schrenk Spruce (*Picea schrenkiana* Fisch. et C.A. Mey.)** — the main forest-forming species of the Tien Shan, an endemic of Central Asia. A powerful tree up to 40–50 m in height, with a trunk diameter of up to 1–1.5 m. The crown is narrow-pyramidal. Needles are four-sided, rigid, prickly, dark green. Cones are large, cylindrical (7–10 cm long), young ones are violet-green, mature ones are brown and pendulous. It forms extensive spruce forests on northern mountain slopes at altitudes of 1700–3000 m, performing an exceptional water-protecting, soil-protecting, and climate-regulating role.
- **Semyonov Fir (*Abies semenovii* B. Fedtsch.)** — the rarest endemic relict species of Tertiary flora, listed in the Red Data Book of the KR. It grows locally in the Inner Tien Shan and the

Fergana Ridge (specifically in the Sary-Chelek Biosphere Reserve). A tree up to 30 m tall with smooth light-gray bark. Needles are flat, soft, blunt, with two white stripes underneath. Cones are cylindrical, upright ("candles"), disintegrating into scales upon maturation directly on the tree, leaving bare axes.

- **Genus Juniper (Archa — *Juniperus* L.)** — a vital mountain-xerophytic woody-shrub formation of Kyrgyzstan. Juniper forests occupy vast areas in the middle and high mountain belts (1500–3200 m). Main species:
  - *Hemispherical Juniper (Juniperus semiglobosa)* — a tree with a spherical crown and scale-like needles.
  - *Zarafshan Juniper (Juniperus seravschanica)* — a tree up to 10–15 m tall, a long-liver (some specimens reach 1000 years or more).
  - *Turkestan Juniper (Juniperus turkestanica)* — a tree or creeping shrub (elfin wood) ascending high into the subalpine belt.

  Archa possesses powerful phytoncide properties, purifies the air, strengthens steep rocky slopes, and prevents mudflows and erosion. Juniper berries and wood are widely used in traditional medicine and pharmacognosy.

3. Class Gnetopsida and Family Ephedraceae

Gnetophytes are an isolated group of gymnosperms combining features of conifers and angiosperms (presence of vessels in xylem, flower primordia). In the arid and high-mountain ecosystems of Kyrgyzstan, representatives of the family Ephedraceae are widely represented.

- **Intermediate Ephedra (*Ephedra intermedia* Schrenk ex C.A. Mey.)** and **Jointed Ephedra (*Ephedra equisetina* Bunge)** — strongly branched xerophytic shrubs 50–150 cm high with jointed, twiggy, grayish-green shoots. Leaves are reduced to small scales fused at the base. Plants are dioecious, wind-pollinated.
- **Pharmacognostic significance:** Green non-woody shoots (herb) of ephedra (*Herba Ephedrae*) contain alkaloids (l-ephedrine, d-pseudoephedrine, norephedrine). Ephedrine is a potent sympathomimetic: it stimulates the sympathetic nervous system, constricts peripheral blood vessels, raises blood pressure, dilates bronchi (relieving bronchospasm in asthma), and stimulates the respiratory center. Because ephedra alkaloids are used for illegal synthesis of psychotropic substances, harvesting, storage, and processing of raw materials are under strict state control.

Conservation aspects: Anthropogenic pressure (excessive livestock grazing, illegal logging of valuable species, forest fires, uncontrolled harvesting of medicinal raw materials) threatens the preservation of the unique gene pools of Schrenk spruce, Semyonov fir, and juniper forests. The creation of reserves (Sary-Chelek, Besh-Aral, Karatal-Jarykcha) and national parks forms the basis for preserving the biodiversity of the KR.

Comparative Characteristics of Main Coniferous and Gnetophyte Forest Formers and Medicinal Plants of the KR

Taxon (Species)	Systematic Position	Life Form	Morphological Features	Distribution in Kyrgyzstan	Economic and Medicinal Significance
Schrenk Spruce *Picea schrenkiana*	Division Pinophyta Class Pinopsida	Tree (up to 40-50 m)	Needles rigid, prickly, four-sided; cones pendulous	Tien Shan, forest belt (1700–3000 m)	Main forest former, timber, water protection
Semyonov Fir *Abies semenovii*	Division Pinophyta Class Pinopsida	Tree (up to 30 m)	Needles flat, soft, with white stripes; cones upright	Inner Tien Shan, Fergana Ridge	Endemic, tertiary relict, Red Data Book of KR
Junipers (Archa) *Juniperus spp.*	Division Pinophyta Class Pinopsida	Tree / shrub / elfin wood	Needles scale-like/ needle-like; succulent berry-cones	Throughout the mountains of KR (1500–3200 m)	Phytoncides, anti-erosion role, essential oils
Ephedra (jointed / intermediate) *Ephedra spp.*	Division Pinophyta Class Gnetopsida	Xerophytic shrub	Shoots jointed, twiggy, green; leaves scale-like	Rocky slopes, arid zones of KR	Source of ephedrine alkaloid (medicinal raw material)

SELF-TEST ASSESSMENT TASKS

1. **The main forest-forming species of the Tien Shan coniferous forests is:**
   A) Semyonov Fir
   B) Schrenk Spruce
   C) Scots Pine
   D) Siberian Larch
2. **A relict endemic coniferous plant species of Kyrgyzstan listed in the Red Data Book, whose cones grow vertically upward and disintegrate on the tree:**
   A) Semyonov Fir
   B) Turkestan Juniper
   C) Schrenk Spruce
   D) Intermediate Ephedra
3. **What is the significance of junipers (archa) in the mountain ecosystems of Kyrgyzstan?**
   A) Only a raw material for obtaining timber
   B) Soil-protective, anti-erosional, and phytoncidal (air purification)
   C) Source of starch production
   D) Forage base for fish

4. **The primary biologically active substance (alkaloid) in ephedra herb is:**
   A) Morphine
   B) Atropine
   C) Ephedrine
   D) Digoxin
5. **To which class do plants of the genus Ephedra belong?**
   A) Pinopsida (Conifers)
   B) Gnetopsida
   C) Cycadopsida
   D) Liliopsida (Monocots)

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