

LECTURE 5

THEME: *Morphology and physiology of the shoot. Metamorphosis of the shoot. The concept of the stem. The anatomical structure of the stem. The anatomical structure of the rhizome. The specificity of the structure of the stems of plants belonging to different taxonomic groups, and its importance for the identification of plants.*

Stem. Shoot.



One of the most important vegetative organs of the plant is the stem. The stem is called the organ of the plant, on which, regardless of the place of growth, normal or modified leaves and buds are located. **Its main function is to create a connection between the other organs of the plant.** The young part of the stem, covered with leaves, is called shoot. The place, where the leaf is attached to the shoot is called the node, and the distance between two neighboring nodes on the shoot is called the internode.

POSITION OF SHOOTS IN SPACE

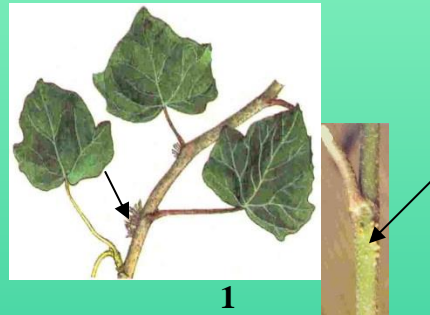
- *A - upright*
- *B – ascending*
- *C –creeping*
- *D - climbing*
- *E –decumbent*
- *(or recumbent) rooted*
- *F -recumbent*
- *non rooted*



A



B



1



C

2



D



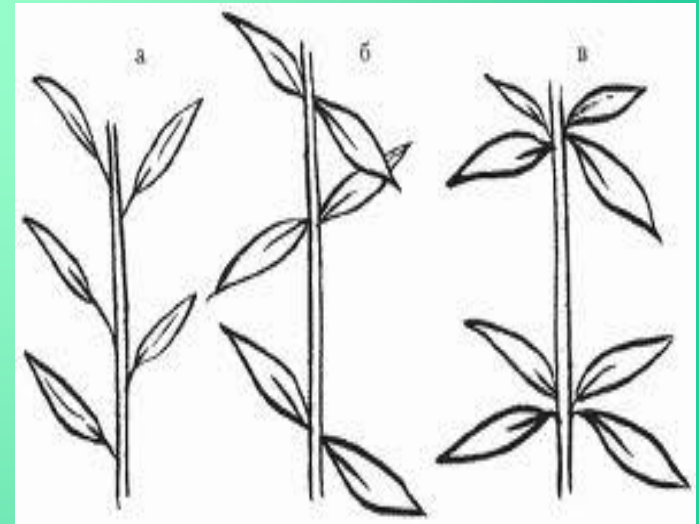
E



F

LEAF ARRANGEMENTS

- There are three types of arrangement of leaves on the shoot: alternate or spiral (A), opposite (B) and whorled (C). The common feature of the various leaf positions is that the leaves, while lying freely on the shoot, do not cast a shadow on each other.
- *Heterophylia*. In Greek, "heteros" is different, "filion" means leaf. *Heterophylia* means diversity in leaves. Usually on the same plant there are leaves of the same type. However, on some fruit plants within the same umbrella leaves differ from each other in volume and shape. Thus, on the mulberry tree, the leaves on the same shoot at the top of the branch have a lobed leaf blade, and the leaves below have a single leaf blade. This phenomenon is called *heterophylia*.



BRANCHING

As a result of the growth of the apical bud, the main stem appears, and lateral branches of the first order are formed from the lateral buds.

In the history of plant evolution, the following branching rules were defined.

1. *Dichotomous branching, or forked.* In this type of branching, growth is provided by one pair of initial-meristematic cells that are located on the top of the shoot. In general, it occurs in many plants and in some gymnosperms.

A real dichotomous branching occurs in these plant representatives. Due to the fact that they have not one, but two initial cells, the shoot separates and branches in the form of a fork. In this case, the cone of growth is also divided. Such a branching is called *dichotomous*. It is considered the oldest branching rule in evolution.

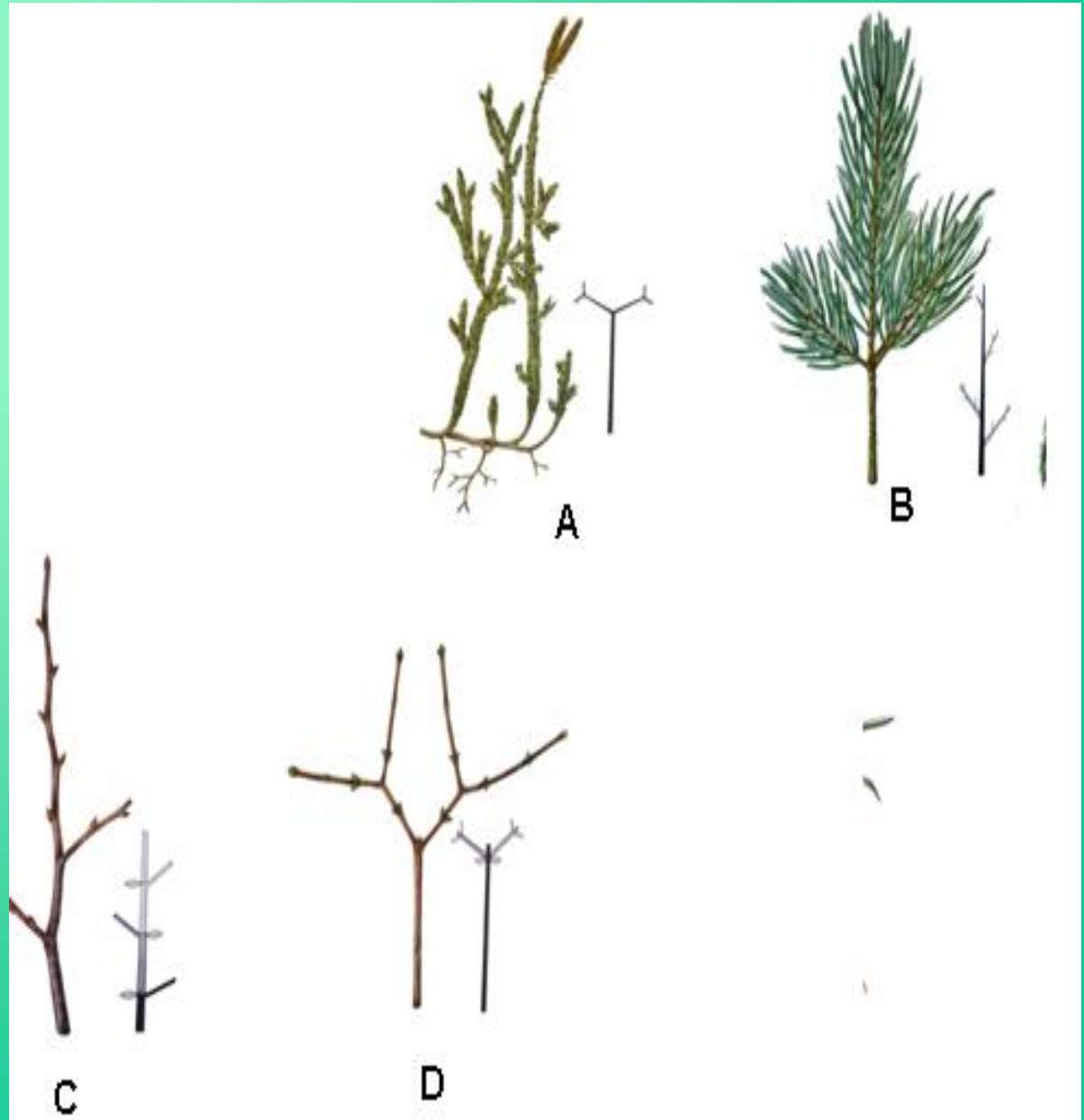
2. *Monopodial branching.* When monopodial branching occurs, the apical bud is constantly in action and is the cause of the formation of a symmetrical shoot umbrella. The lateral buds, as well as the apical buds, always continue their activity.

3. *Sympodial branching.* With this branching rule, the apical bud ceases its activity very quickly; at this time, the growth of the branch forward is provided by the lateral bud, located near the apex. As a result, the stem can not assume a symmetrical high appearance. Its main and lateral branches consist of separate axes, sympodia.

Sympodial branching is most common in angiosperms. In most plants monopodial and sympodial branching are observed in a mixed form.

4. *Pseudodichotomous branching.* Pseudodichotomous branching occurs in some representatives of flowering plants. Here, the apical bud also ceases very quickly. Because of the blossoming of flowers, its growth stops. The growth of the shoot or branch continues at the expense of two lateral buds, arranged in pair near the apex bud; as a result, the shoot again bifurcates. A pseudodichotomic branching rule occurs in carnation family, jasmine, horse chestnut, maple, elderberry and other plants.

Branching types



A – dichotomous

B – monopodial

C – sympodial

D – pseudodichotomous

BUDS:

Due to the place, occupied on the stem, the buds are divided into two groups: apical and lateral. Both the apical buds and the lateral buds are called axillary buds because of the location in the axil of the leaf. These buds, in the process of their growth, ensure the growth of the stem up and to the side. Sometimes, due to the fact that these buds lag behind in development for one year or several years, they are called sleeping. Just like the leaves, the location of the axillary buds on the stem can be alternate, opposite and whorled. For example, in cherry, birch, bird cherry, hazel, etc., the buds have an alternate arrangement; Mint, basil, jasmine, etc. - opposite; and the horsetail and the crow's eye - whorled.

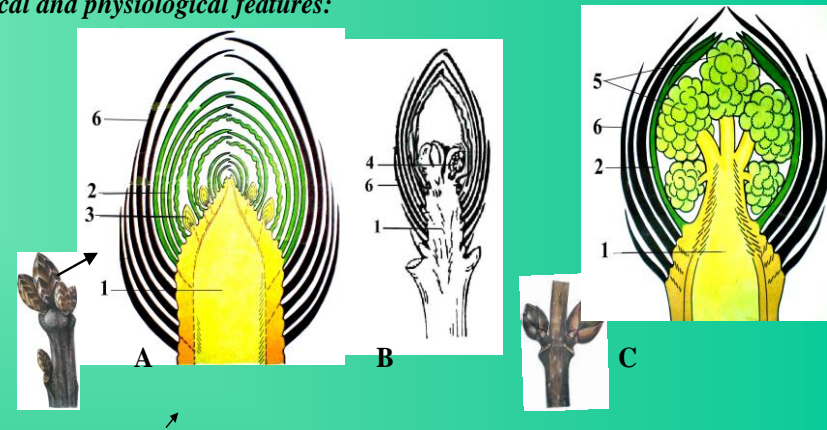
The buds are covered with scales on the outside. In the center of the bud there is a rudimentary stem and rudimentary leaves, in other words, a rudimentary stem with leaves. Buds, in which the embryonic stem is surrounded by rudimentary leaves are called leaf buds, if surrounded by rudimentary flower, then flower buds. In the leaf bud appears a leaf, and in the flower bud - a flower. The end of the stem is called the cone of growth.

Structure of buds and their classification.

As for their morphological and physiological features:

- A - vegetative bud
- B - generative (or floral) bud
- C - vegetative-generative (or mixed) bud

- 1 - rudimentary stem with the cone of growth
- 2 - rudimentary leaves - primordials
- 3 - rudimentary buds
- 4 - rudimentary flower
- 5 - rudimentary inflorescence
- 6 - buds' scales



METAMORPHOSIS OF THE STEM

Metamorphosis of the stem can be divided into two groups: overground and underground.

Underground metamorphosis of the shoot is very important for the plant. They facilitate the residence of plants in unfavorable conditions, help it to overwinter, protecting from cold at a certain depth of the soil, and in the summer they protect plant from drying out.

Underground metamorphosis of the shoot include rhizome, bulb and tuber.

The structure of the bulb is very similar to that of buds. This is not only a modification of the shoot, the leaves on its surface, turning into organs of accumulation of reserve nutrients, unusually swells and completely lose the chlorophyll grains.

Bulb of garlic is complex. In the axil of each scale are formed bulb-babies (commonly known, so-called denticles). Bulb varieties were also obtained, such as simple ones, with round bulbs.

In some plants, the overground organs are also form bulbs, for example, in leaf axils, in inflorescences, etc. Since such bulbs are small, they can be called onion bulbs. They are a modification of leaf and flowering buds. These bulbs can be seen in onions, lilies.

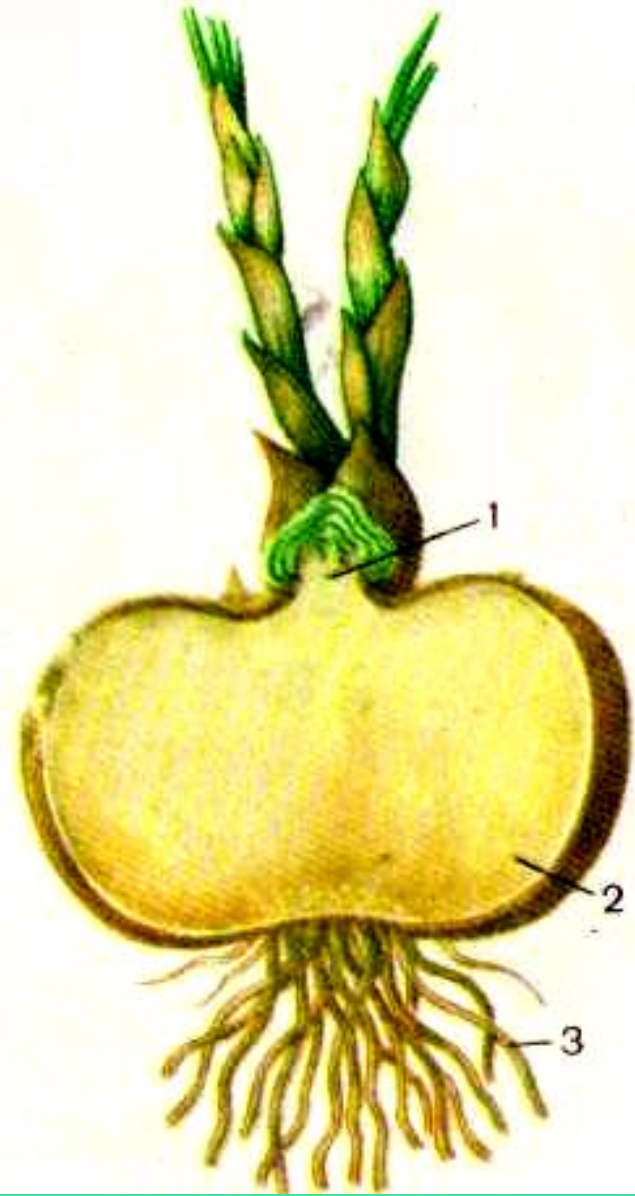
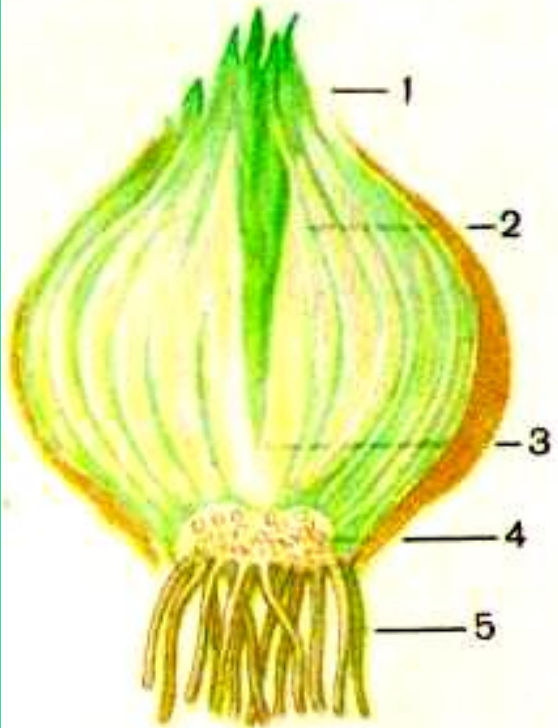
Rhizome is the most widespread metamorphosis of the stem, among monocotyledonous, as well as among dicotyledonous. In the dog's tooth grass, sorghum, reed, the rhizome is elongated, and in iris and canna is shortened.

Many overground metamorphosis of the shoot appeared as a result of adaptation to the influence of the humidity factor. Some plants that grow in arid places lose their leaves, turn into leafless shoots, or their leaves are reduced to the highest degree, and thus the surface of evaporation of the plant decreases significantly. Many plants of deserts and semi-deserts form a type of stem that can withstand a prolonged drought. Such plants, which have a fleshy, juicy stem, are called succulent plants. These include cacti, African spurge, many solanchak plants that grow on the Kura-Araz lowland.

The overground metamorphosis of the shoot also include the tendrils and thorns. Tendrils occur in lianas. With their help, the lianas are attached to the support and rise upwards. Tendrils are common in grapes and representatives of the pumpkin family. Thorns are found in representatives of different families.

Metamorphoses of stem are interesting not only for their appearance, but also for changes occurring in the internal structure.

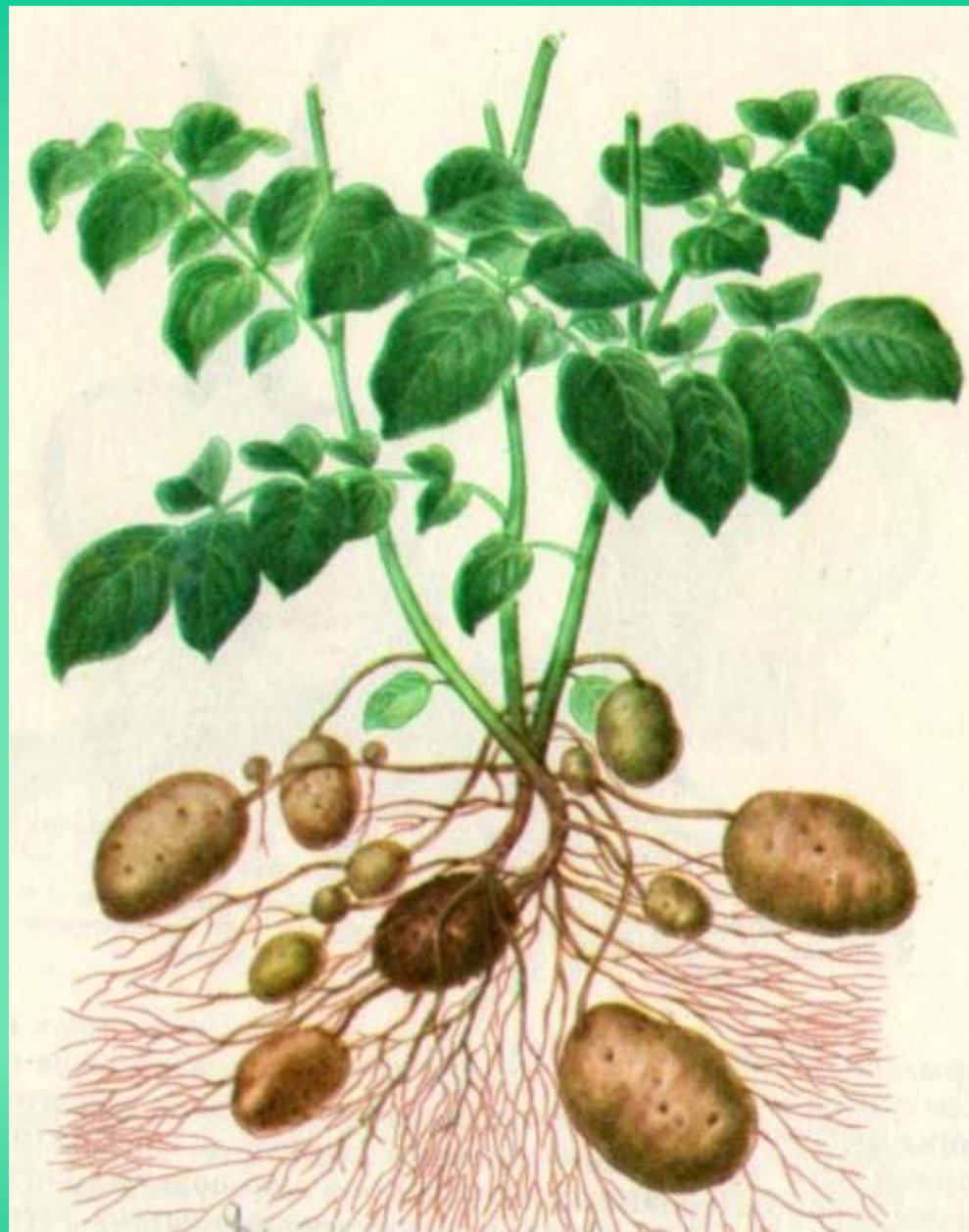
Tendrils and spines, in the main, preserve the structure of the stem. Succulent plants have rapidly developed cores and rays of the core of a very large volume, filled with juice, consisting of parenchymal cells that retain water reserves.



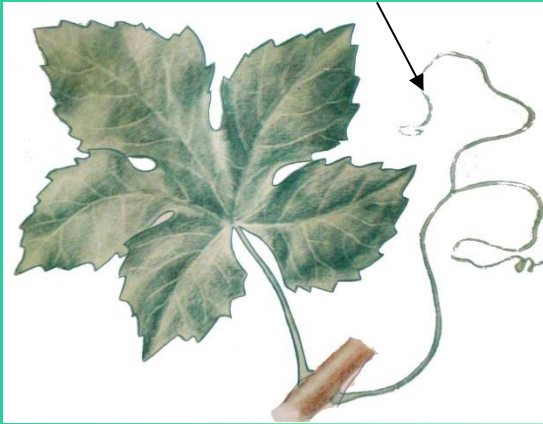
•Bulb



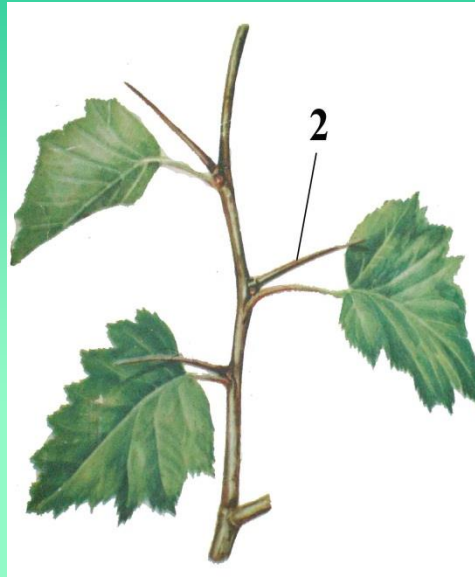
rhizoma



Tuber



Tendrils



Thorns



Succulent stem

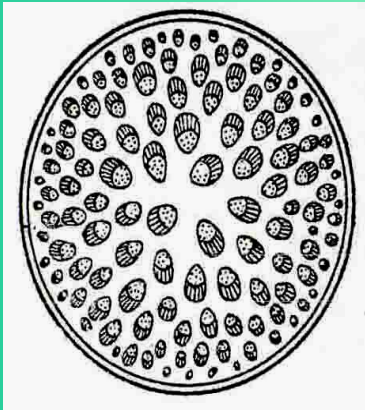


Cladophylls

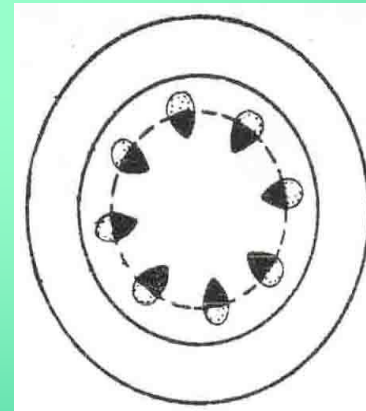
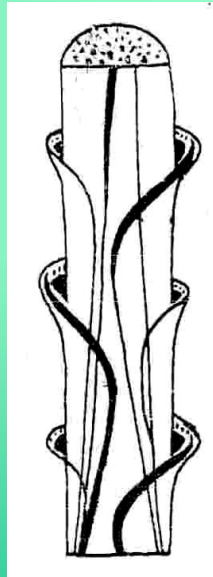
ANATOMICAL STRUCTURE OF THE STEM

There are two types:

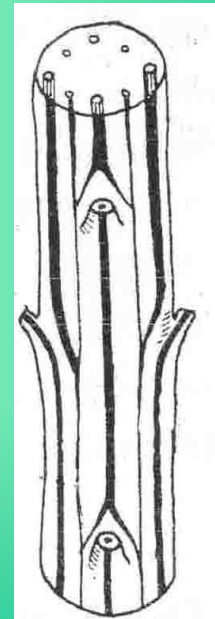
- Bundle (conductive tissues are arranged in bundles)
- Non-bundle (conductive tissues are arranged in the form of a cylinder).



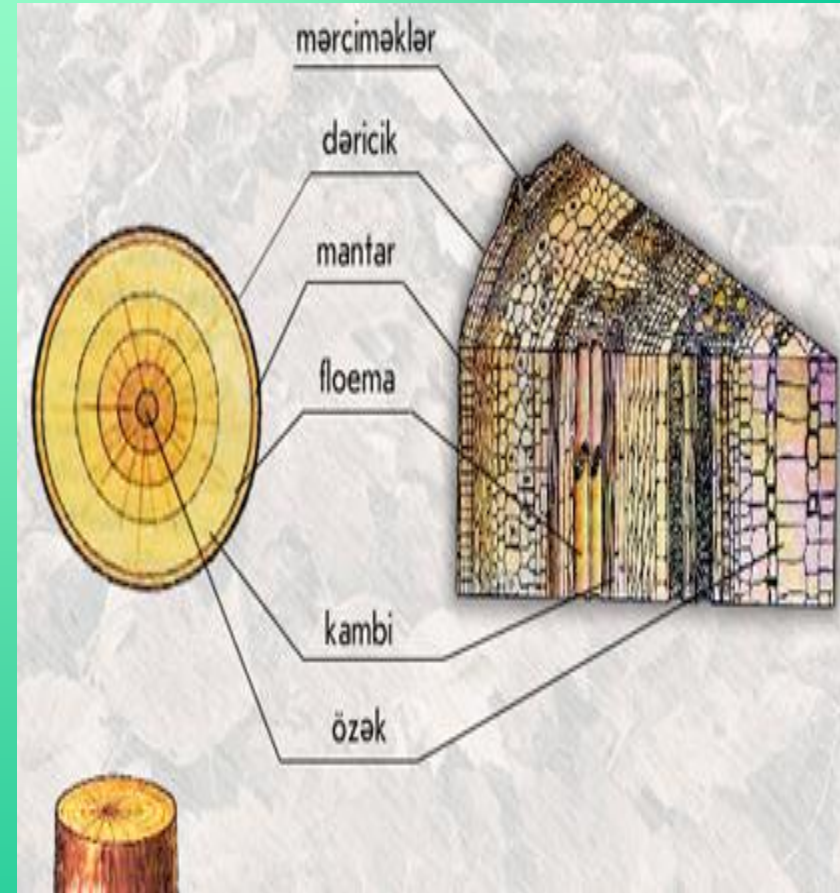
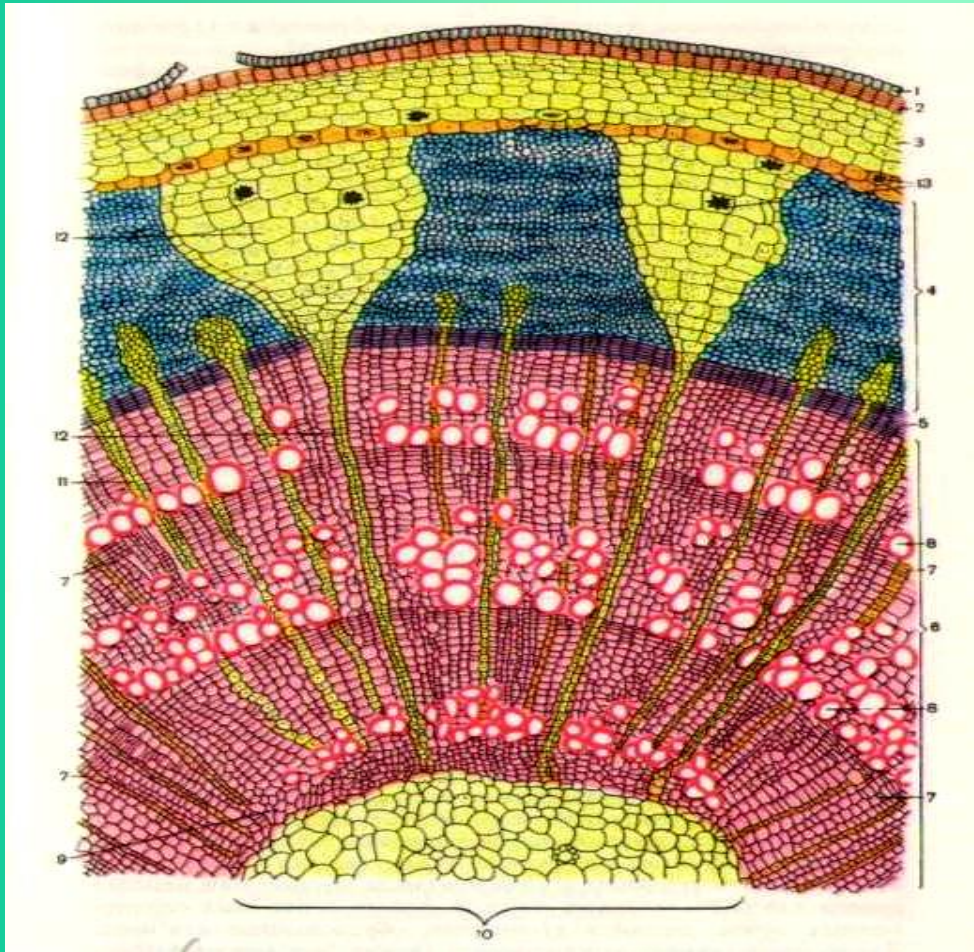
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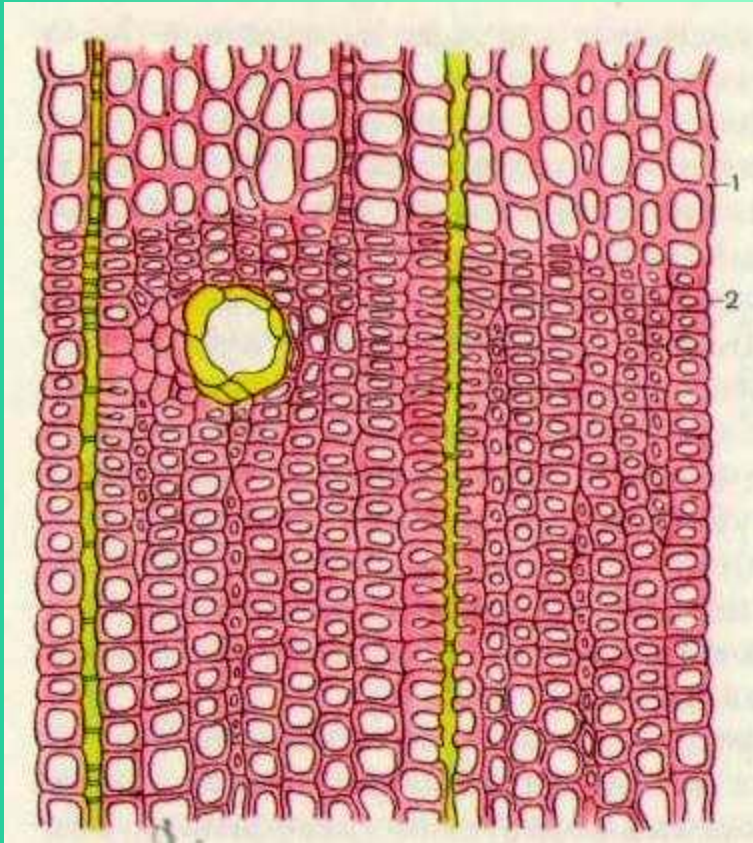
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A CHARACTERISTIC FEATURE OF PERENNIAL STEMS OF TREES AND SHRUBS IS THE FORMATION OF CORE LAYER EVERY YEAR IN THE FORM OF RINGS (ANNUAL RINGS) AND CORTEX AND SECONDARY COVERING TISSUE BY CAMBIUM TISSUE, CAUSING STEM SEALING.



Tracheids formed on the trunk of a pine tree in spring (1) and in autumn (2)



- The woody part of gymnosperms, consisting mainly of tracheids, has a conductive and mechanical functions, in phloem there are no accompanying cells, trachea and libriform.

THANK YOU FOR ATTENTION!

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