

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
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Біологічний факультет
Кафедра ботаніки

БОТАНІКА. МОРФОЛОГІЯ РОСЛИН

Методичні вказівки
до лабораторних робіт для студентів I курсу біологічного факультету
спеціальності 091 «біологія»,
які поглиблено вивчають англійську мову

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Ботаніка. Морфологія рослин / Методичні вказівки до лабораторних робіт для студентів I курсу біологічного факультету спеціальності 091 «біологія», які поглиблено вивчають англійську мову – Одеса, 2017 .- 45 с.

Методичні вказівки призначені студентам першого курсу денної форми навчання, які виконують лабораторні роботи з курсу «Ботаніка. Морфологія рослин» та поглиблено вивчають англійську мову

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Вступ

Методичні вказівки включають лабораторні роботи з розділів «Вегетативні органи рослин» та «Генеративні органи рослин» і складаються з окремих тем, які відповідають програмі навчального курсу «Ботаніка. Морфологія рослин». Кожна тема містить завдання, що студенти мають виконати у ході лабораторної роботи, а також короткий нарис, який включає перелік та пояснення основних термінів, необхідних при підготовці до лабораторної роботи. У кінці наведено короткий словник термінів англійською та українською мовами. Кожна робота проілюстрована рисунками з відкритого доступу та книги «Plant Systematics: A Phylogenetic Approach».

Після кожного терміну у дужках латиною наведено приклад рослини, яка має цю ознаку.

Протоколи лабораторних робіт мають бути оформлені в альбомі для лабораторних робіт та підписані викладачем, який проводить заняття.

Methodical directions include laboratory works from “Vegetative organs of plants” and “Generative organs of plants” and consists of topics, which are conformed to the program of normative course “Botany. Morphology of plants”.

Radix, its functions and modifications

Task

1. Examine the offer material
2. Sketch and designate:
 - roots groups for ontogenesis origin,
 - main morphological types of root systems,
 - root metamorphoses

Radix (root) is the axis vegetative organ of plants, which has unlimited growth lengthwise, radial symmetrical construction, positive geotropism and negative heliotropism. There are no buds or leaves to be in determine order on them.

Main functions of roots are *mechanical* or support and *trophic* or absorb. Besides it root can synthesize some substances, accumulate nutrient substances, take part in vegetative reproduction, interact with roots another plants, with microorganisms and mushrooms to create allelopatic background.

For *origin* in ontogenesis there are *main (primary)*, *lateral* and *additional (secondary)* roots (fig. 1).

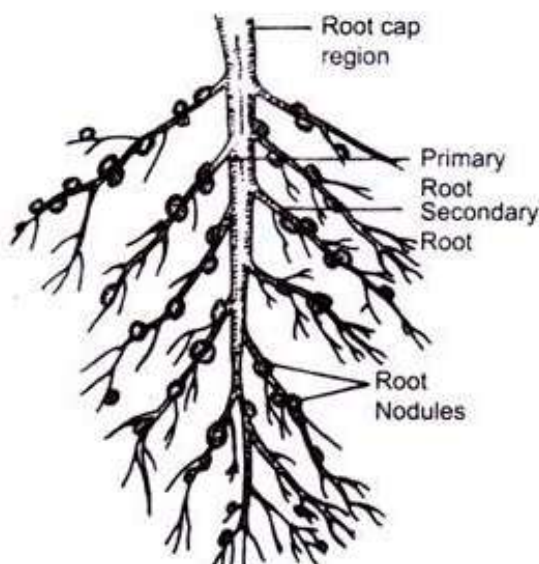


Fig. 1 Origin of roots in the ontogenesis process

The aggregate of all roots of plant named *root system*. There are such main types of root systems: *pivotal*, *fibril* and *branchy* (fig.2)

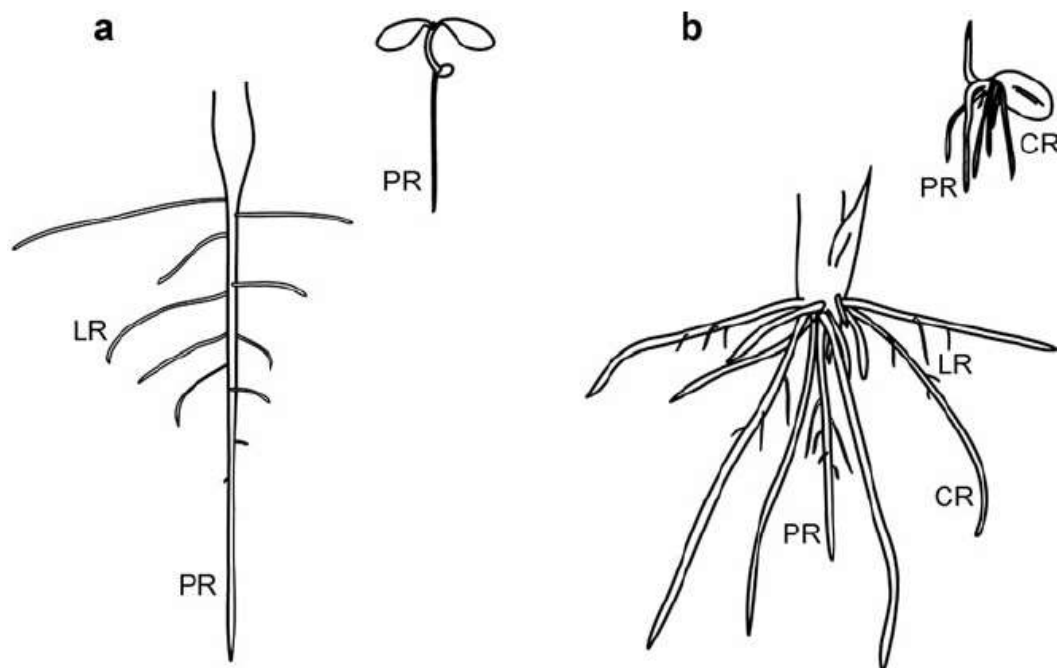


Fig. 2. Two main types of root systems: pivotal (a), fibril (b)

In another system of classification the root system by origin of roots, we can sign *primary gomorrhize*, *secondary gomorrhize* and *allorrhize* systems.

Roots can change their selves from conditions of life. The change, which inherited, names *metamorphosis*. There are such metamorphosis of roots (fig.3):

- *root-crop* - the change of main root (*Daucus sativa*)
- *root-cone* – the change of lateral or additional roots (*Dahlia pinnata*)
- *root-sucker* (*Cuscuta europaea*)
- *root-hitching* (*Hedera helix*)
- *photosynthesis root* (*Orchidaceae*)
- *root as board* (*Populus*)
- *pulled root* (*Allium cepa*)
- *root-spine* (*Myrmecodia*)
- *stilts-roots* (mangrove plants)
- *air-roots* (*Monstera*)
- *breathing-roots* (*Taxodium distichum*)
- *roots as post* (*Ficus bengalensis*)

Changes of roots, which appeared for symbiosis with mushrooms, named *mycorrhiza* and with bacteria – *bacteriorhiza*. Mycorrhiza may be exotrophe, mesotrophe and endotrophe.



Prop root
Ficus elastica



Stilt root
Zea mays



Climbing root
Piper sp.



Tuberous root
Ipomoea batatas



Nodulose root
Curcuma amada
Costus speciosus



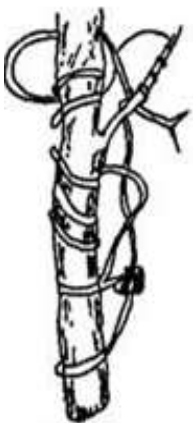
Fasciculated root
Dahalia sp.



Moniliform root
Dioscorea alata



Annulated root
Psychotria



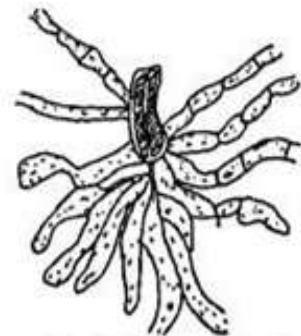
Sucking root
Balpnophora



Respiratory root
Rhizophora



Epiphytic root
Dendrobium sp.



Assimilatory root
Podostemaceae sp.
Trapa natans

Fig. 3. Metamorphosis of roots

Questions and tasks

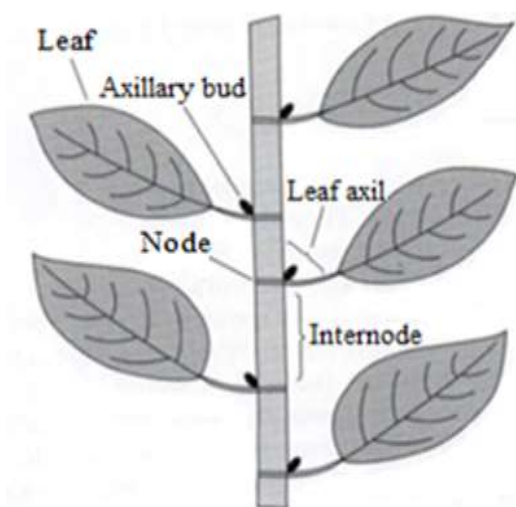
1. What is a root? What are the main functions of it?
2. Describe please origin and evolution of root.
3. What are the main and additional function of root?
4. What are the main types of the root systems?
5. Indicate metamorphoses of root and the plants, which have it.

Sprout and stem

Task

1. Examine the offer material
2. Sketch and designate:
 - stems by direction of growth,
 - forms of stems,
 - main types of branding
 - metamorphoses of sprout

Sprout is over ground vegetative part of plants, which consists from stem, leaves and buds. Stem (fig.4.) (*clados*) is axis vegetative organ of plants, which has radial symmetry, positive *heliotropism* and negative *geotropism* and consists from **nodes**, where leaves and axillary buds are produced, separated by **internodes**. It has buds and leaves, which are disposed on it in definite order.



Main functions of stem are mechanical, passing (transport) and carrying other vegetative and generative organs.

Fig.4. A general angiosperm stem showing *nodes*, *internodes*, leaves, leaf *axils*, axillary *buds*.

To direction of growth, there are sprouts **ortotrope** and **plagiotrope**.

To **disposition in space**, there are such sprouts:

- **straight** (*Quercus*)
- **twine** (for watch pointer – *Humulus lupulus*, against watch pointer – *Convolvulus arvensis*)
- **clutching** (*Vitis vinifera*)
- **raising** a little (*Polygonum aviculare*)
- **creeping** (*Fragaria vesca*)
- **lying** or spreading (*Tribulus terrestris*)
- **climbing** (*Hedera helix*)

We can see such forms of stems in transversal cutting:

- **roundish** (the more of plant)
- **polyhedral** (many cactuses)
- **tetrahedral** (*Mentha piperita*)
- **triquetrous** (*Carex*)
- **ribbing** (*Equisetum*)
- **winged** (*Lathyrus sylvestris*)
- **straw** (*Poaceae*)

Branding. There is such main types: apex and lateral. Apex branding named **dichotomical**. Lateral branding can be **monopodium** and **sympodium**.

We may divide metamorphosis of sprout and stem (fig.5). Between metamorphoses of sprout we can indicate

- **tubers** - a swollen, fleshy portion of rhizome, involved in water or carbohydrate storage over ground and underground (*Solanum tuberosum*, *Brassica caulocarpa*)
- **bulbs** over ground and a short, erect underground stem, surrounded by thick, fleshy leaves or leaf bases (*Allium cepa*)
- **tuber-bulbs** (*Crocus vernus*)

- **rhizome** horizontal and vertical stem, often underground or lying along the surface of the ground, bearing scale like leaves (*Acorus calamus*, *Valeriana officinalis*),
- **stolon** or **runner**- horizontal stem, lying along the surface of ground and having an elongated internodes (*Fragaria vesca*)
- **phyllocladium** (stem as leaf) (*Ruscus pontica*)
- **thorn** – a reduced, sharp-pointed stem (*Gleditsia*) (for leaf or stipule it names spine)
- **assimilative** (*Equisetum*)
- **twinning** (*Vitis vinifera*)

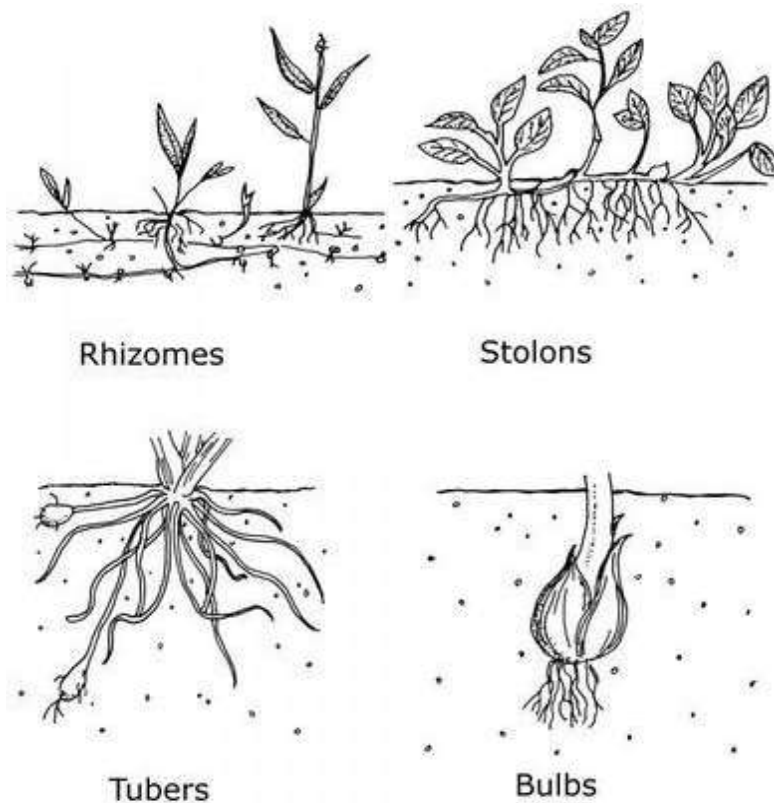


Fig.5. Some metamorphoses of sprout

Bud or gemma

It is rudimentary sprout, which has cone of growth and rudiments of leaves on it. Buds on the stem may be **apex**, **lateral** and **adventive**. For functions there are **vegetative**, **generative** and taking out buds. For morphological construction they can

be *naked* (not covered by bud scales or stipules) and *shut* and for placing on the stem – *next* in turn, *opposite*, *annular*, *serial* and *collateral*.

axillary – bud, located in the leaf axil

flower – bud, containing embryonic flower

leaf – bud, containing embryonic leaves

mix – bud, containing both embryonic flowers and leaves

terminal – bud at the apex of a stem (in monopodial shoots)

Questions

1. What is sprout? What functions it has?
2. What parts the sprout is consists from?
3. Name the types of stems in direction of growth
4. Name the forms of stems and plants which have them
5. Main types of stem metamorphoses
6. What is a bud and what its main function?
7. What are bud's type in morphological construction?
8. What are bud's type for placing on the stem?

Leaf

Task

1. Examine the offer material
2. Sketch and designate main types of leaves by
 - form of leaf plate
 - graft,
 - base of leaf plate
 - apex of leaf plate
 - form of leaf plate
 - venation
3. Sketch and designate compound leaves
4. Sketch and designate metamorphoses of leaves

It is lateral, mono symmetrical, usually flat vegetative organ. Leaves have one surface facing toward the stem axis (*adaxial* or upper surface) and another surface facing away from the stem axis (*abaxial* or lower surface).

Most leaves are *bifacial*, but some of them are *unofacial*. Leaf has such main function: photosynthesis, interchange of gases (respiration), transpiration and educe. It consists from: *leaf plate, graft, base of leaf* and *stipules*. If graft is absent, leaf is sessile (fig.6).

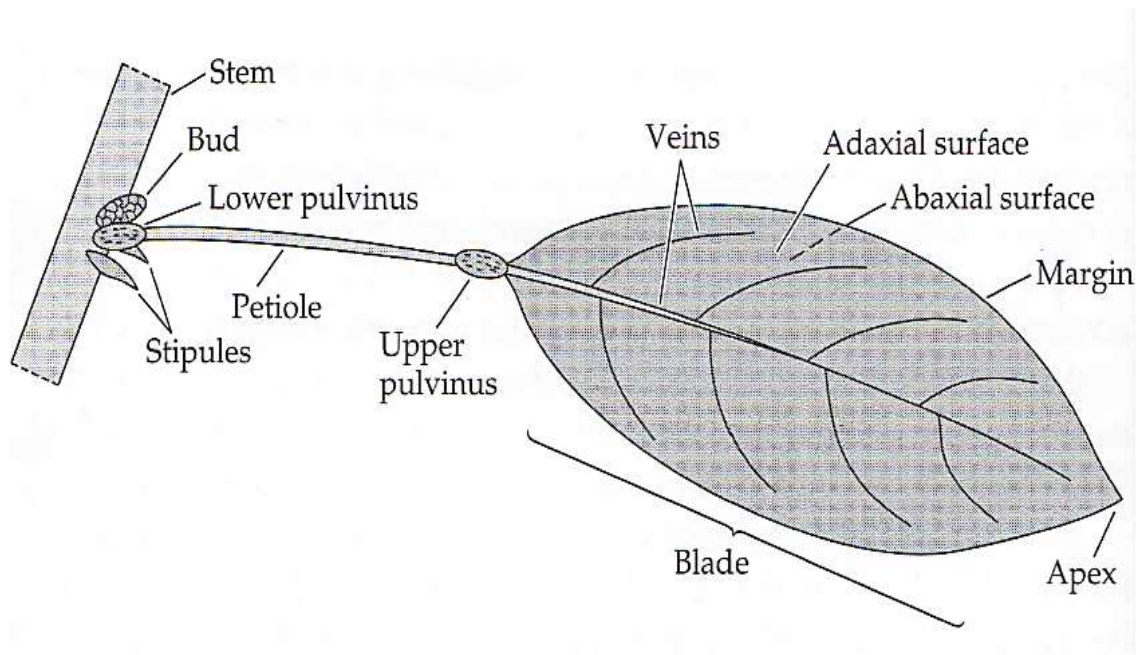


Fig.6. Parts of angiosperm leaf

Leaves may be *simple* and *compound*. Compound leaf has some leaf plates on one graft, which names rachis. During defoliation in contrast to simple leaf, firstly fall out leaf plates and then – rachis.

There are such types of compound leaves (Fig.7):

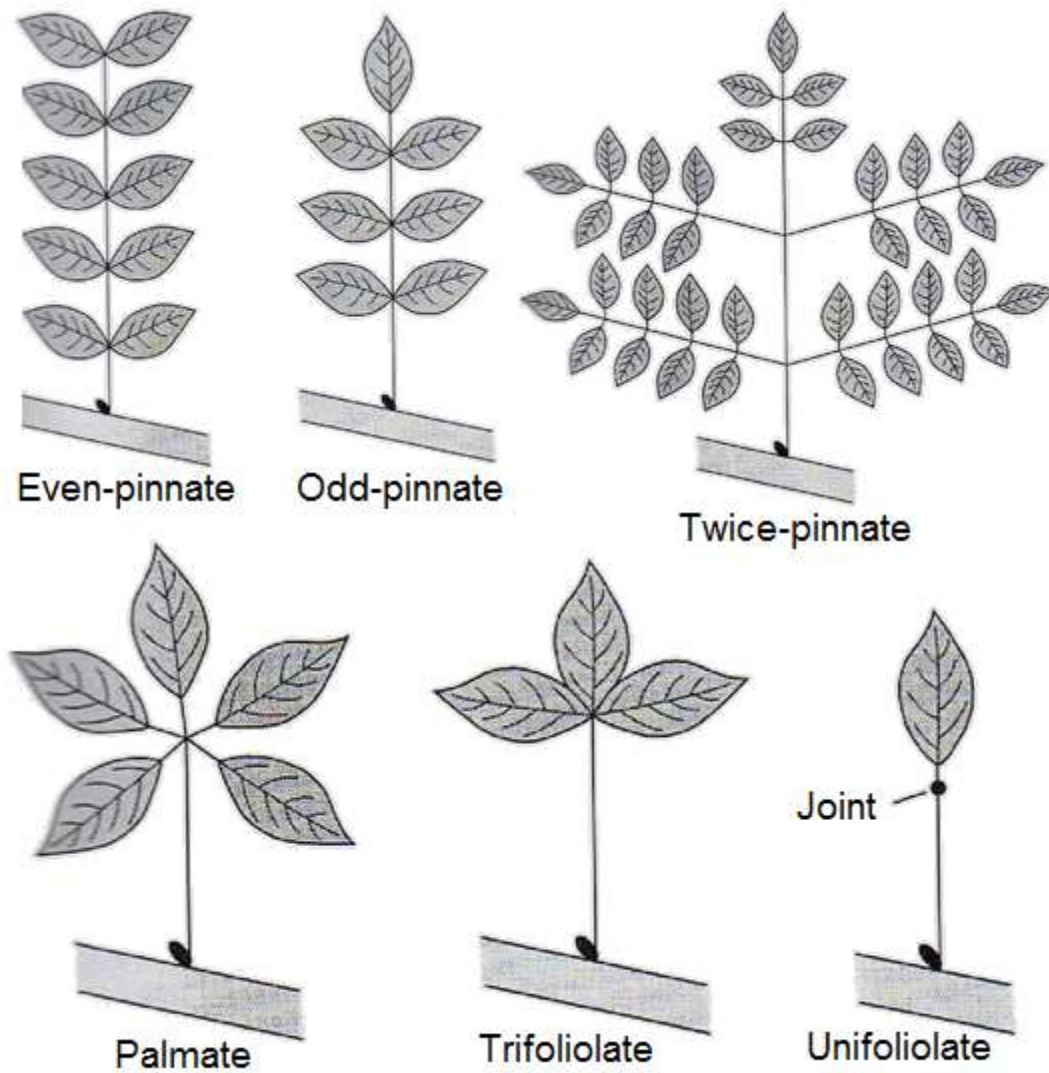


Fig.7.Types of compound leaves

Their arrangement is on fig.8. It may be *alternate* (when leaves are born singly in node), *opposite* (when two leaves placed on opposite sides of stem) and *whorled* (when such leaves three or more).

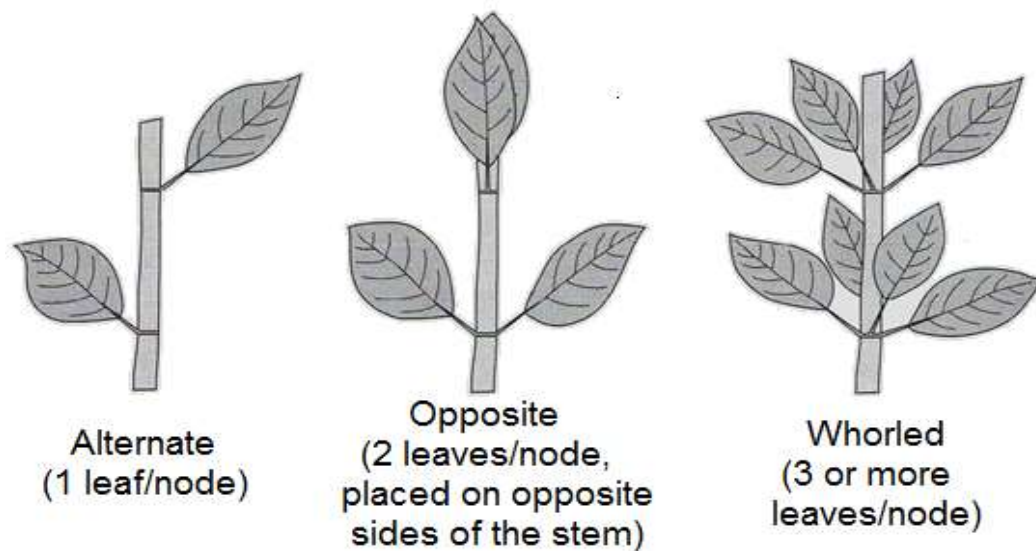


Fig.8. Arrangement of leaves.

The form of leaf plate we can define by correlation between its length and wide and likeness with some geometrical figures. It may be *ovate* (widest near base), *obovate* (widest near apex), *elliptic* (widest near middle), *oblong* (parallel sides) etc.

The base of leaf plate may be (fig.9)

acute (*Salix alba*)

rounded (*Pyrus*)

cordate (*Syringa*)

sagittate (*Sagittaria*)

lobate (*Convolvulus arvensis*)

non alike side (*Ulmus*)

truncate (*Populus deltoides*)

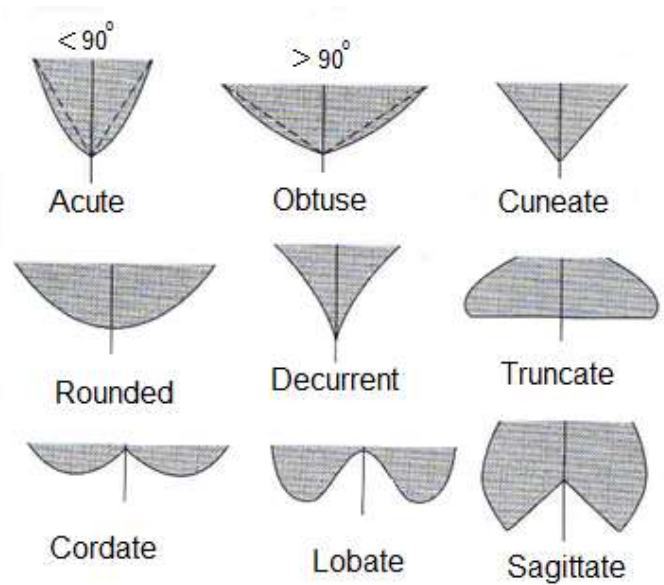
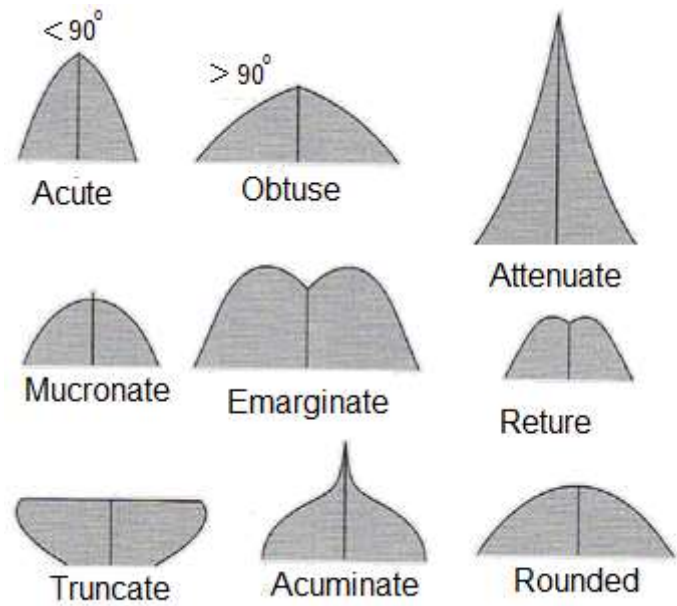


Fig.9. Leaf base shapes

The apex of leaf plate may be (fig.10)

- ***rounded*** (*Cotinus coggygia*)
- ***attenuate*** (*Secale cereale*)
- ***mucronate*** (*Tilia cordata*)
- ***acuminate*** (*Caragana*)
- ***emarginate*** (*Ginkgo*)



- Fig.10. Leaf apex shapes

By form of leaf **margin** they can be with whole edge (*entire*) and opposite. The leaf plate with no whole margin divided to

- **dentate** (*Viburnum lantana*)
- **serrate** (*Urtica dioica*)
- **-crenate** (*Pelargonium*)
- **-hollow** (grove) (*Campanula rotundifolia*)
- **ciliary** (*Vinca herbacea*).

Venation of leaf plate had such types:

- **dichotomic** (*Ginkgo*)
- **pinnate**, midvein, or primary vein, when leaf has one prominent vein
- **palmate**
- **parallel**.

Some kinds of secondary veins for pinnate and palmate are on the fig.11.

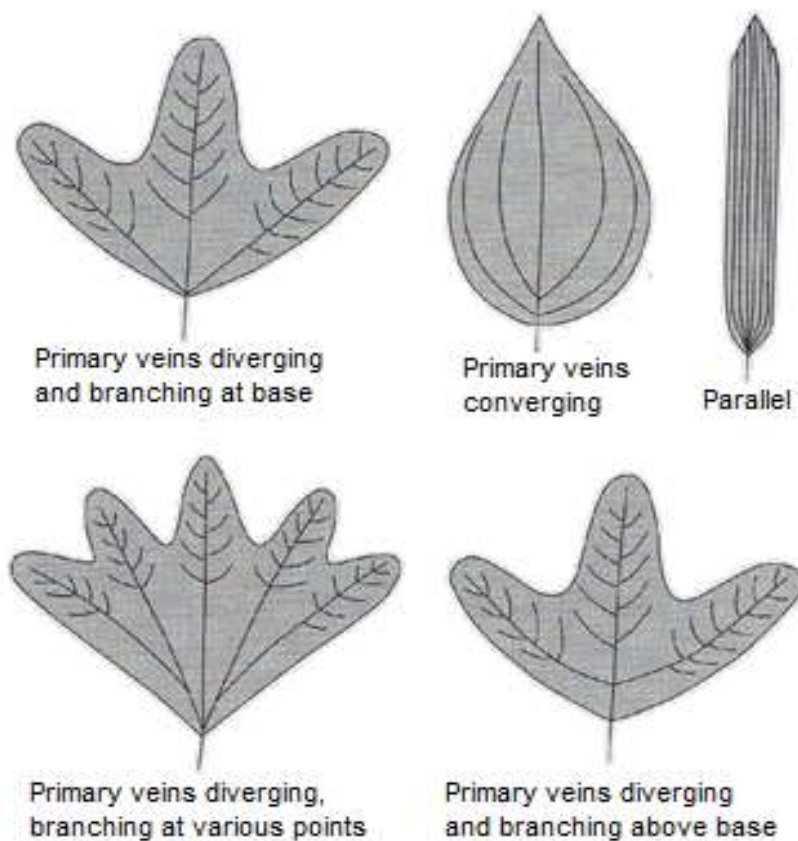


Fig. 11. Some kinds of palmate venation and parallel venation

When depth of leaf plate' cut is more than one third of its wide, it is supposed dismembered. In this case, there are such type of leaves:

- **blade** with pinnate-blade (*Quercus robur*) and digitated-blade (*Acer platanoides*)
- **divided** with pinnate-divided (*Senecio*) and digitated-divided (*Geranium*)
- **cut** with pinnate-cut (*Achillea*) and digitated-cut (*Potentilla*)
- **trifoliate** (*Trifolium*)
- **palmate** (*Aesculus hippocastanum*)
- **pinnate**, between them there are even-pinnate (*Caragana*) and odd-pinate (*Juglans regia*).

Compound leaves may be twice (*Gleditsia*) and three times (*Aethusa*) pinnate.

Metamorphoses of leaves may be such:

- **little tendrils** for climbing (*Pisum*)
- **spines** (*Berberis* – leaves, *Robinia* - stipules)
- **scales** (buds)
- **catching leaves** of plant for capturing insects (*Drosera*, *Nepentes*)
- **providing homes** for ants or mites
- **phyllodiums** – changes of grafts (*Acacia*)
- **water storage** (*Sedum*, many succulents)

Questions

1. What is leaf ? Name its main functions
2. What parts has leaf? What are their functions?
3. Which leaves named simple and compound?
4. How we can indicate the form of leaf plate?
5. Name the main types of leaves' venation
6. Name the forms of apex and base of leaf plate
7. Name the main types of compound leaves
8. Name the metamorphoses of leaves

Flowers

Task

1. Examine the offer material
2. Sketch and designate:
 - flowers of *Cerasus vulgaris* and *Pisum sativum* and indicate their main parts
 - main types of flower' symmetry,
 - main parts of stamen
 - main parts of carpel
3. Consist flower formulas of *Tulipa hybrida*, *Malus domestica*, *Capsella bursa-pastoris*, *Robinia pseudoacacia*.

Flower (flos) is modified sprout with limited to grow, where formatted mega- and microspores, join gametes (fig. 12).

- Main parts of flower are:
- **pedicel**
- **receptacle** – floral axis
- **perianth** –(simple – only with corolla or calyx, double – with corolla and calyx and naked – without corolla and calyx)
- **calyx** (its sepals may be connate and distinct, a.e. *syncepalous* and *aposepalous*)
- **corolla** (its petals may be connate and distinct, a.e. *sympetalous* and *apopetalous*)
- **stamen** (androecium)
- **carpel** (gynoecium)
- **nectar - producing glands** (nectaries).

Some flowers have an “extra” series of floral parts, called corona. Those structures may be outgrowth of perianth parts, stamens, or receptacle, and are extremely diverse in form and function.

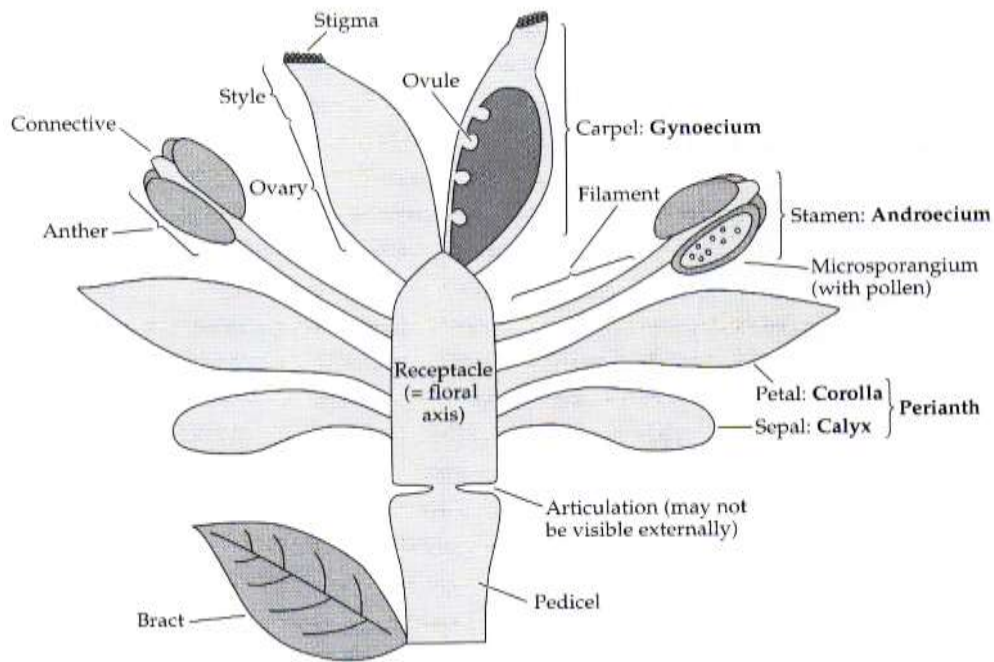


Fig. 12. Parts of generalized flower.

For type of symmetry, there are *radial* (two or more planes of symmetry) or *actinomorphic*, or *regular*, *bilateral* (one plane of symmetry) or *zygomorphic*, or *irregular* and *asymmetrical* (no plane of symmetry) corollas (fig.13).

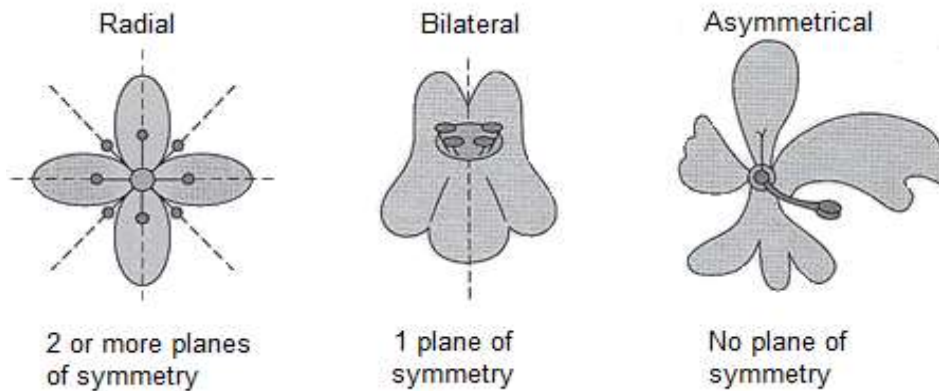


Fig.13. Patterns of flora symmetry

Main types of radial connate corollas:

- **wheel-shaped** (*Myosotis*)
- **bell-shaped** (*Convolvulus*)
- **tube-shaped** (*Helianthus* – central flowers)
- **funnel-shaped** (*Nicotiana*)

- **saucer-shaped** (*Syringa*)
- **cap-shaped** (*Vitis vinifera*)

Main types of bilateral connate corollas:

- **two-lips-shaped** (*Lamium*)
- **tongue-shaped** (*Calendula*)
- **spur-shaped** (*Linaria*)

Androecium is aggregate of stamens in flower. Stamen may be from one (*Lemna minor*) to some hundred. Stamen consists from **filament** and **anther**. **Anther** usually contains four pollen sacs or microsporangia and these are often confluent in two parts, which have connective.

Gynoecium is aggregate of **carpels**, which create one or some pistils. **Pistil** consists from **stigma**, **style** and **ovary**. Carpels may be distinct or connate. If they are distinct, the term pistil is equivalent in meaning to the term carpel, i.e. gynoecium named **apocarps**. If the carpels are connate, gynoecium named **cenocarp**. Cenocarp gynoecium may be **syncarp**, **paracarp** and **lisicarp**. Place of ovules, where fasten to seed embryos, names **placentas**.

Floral parts may be attached to the receptacle in various ways. There are three main types: **hypogenous** (perianth and androecium are inserted below gynoecium), **perigenous** (cuplike or tubular structure surrounds the gynoecium) and **epigenous** (perianth and stamens are on the upper part of ovary).

Floral **formulas** consists from five symbols:

symmetry – it may be radial -*, bilateral – X, asymmetry - \$

number of sepals

number of petals

androecial item

number of carpel

The line below the carpel number indicated the position of the ovary with respect to other floral parts. If the flower is hypogenous, line is superior. If the flower if epigenous, the line have been drown above.

Connation is indicated by a circle around the number.

At the end of the floral formula we indicate fruit type.

For example, $*\overset{\circ}{5}, \overset{\circ}{5}, 10, 3$, capsule.

In our system this formula has such signs: $*\overset{\circ}{\text{♂}}\overset{\circ}{\text{♀}}\text{K}_5 \text{C}_5 \text{A}_{10} \text{G}(\overset{\circ}{3})$, where

K, or Ca – calyx

C, or Co – corolla

A – androecium

G – gynoecium

If the parts are connate, we use - (). At the end there is no indication fruit type.

Questions

1. What is flower? What are its main parts and their functions?
2. Name the types of flower' symmetry
3. Name the main types of radial and bilateral corollas?
4. What parts have androecium and gynoecium?
5. How we can consist flower/ formula?

Inflorescences

Task

1. Examine the offer material
2. Sketch and designate:
 - types of inflorescences
 - main types of indeterminate and determinate inflorescences

Inflorescences is “the shoot system, which serves for formation of flowers and which is modified accordingly”. It is important to look on the arrangement of flowers. There two quite different inflorescences types: *determinate* or monotelic fig. 15 (the main axis of the inflorescences ends in a flower) and *indeterminate* or polytelic fig. 14 (produced only lateral flowers or partial inflorescences). Their comparison characteristic is in table 1.

Table 1

Comparison characteristic of different inflorescences types

Sign	Indeterminate, botrys inflorescences	Determinate, cymo inflorescences
Type of branding	Monopodium	Sympodium
Type of growth	Indeterminate	Determinate
Main axis	It is expressed	It isn't expressed
Quantity of flower and lateral axis	Indetermined	Determined
Opening of flowers	Basypetally	Acropetally

In fig.14 there are indicated simple indeterminate inflorescences.

Between them there are:

raceme (*Robinia, Convallaria*)

spike (*Plantago*)

umbel (*Allium, Primula*)

head (*Medicago*)

capitulum (*Helianthus*)

corymb (*Crataegus, Spiraea*)

panicle (*Vitis, Poa*)

thyrsi - inflorescence, which have signs of both types (*Alnus, Betula*)

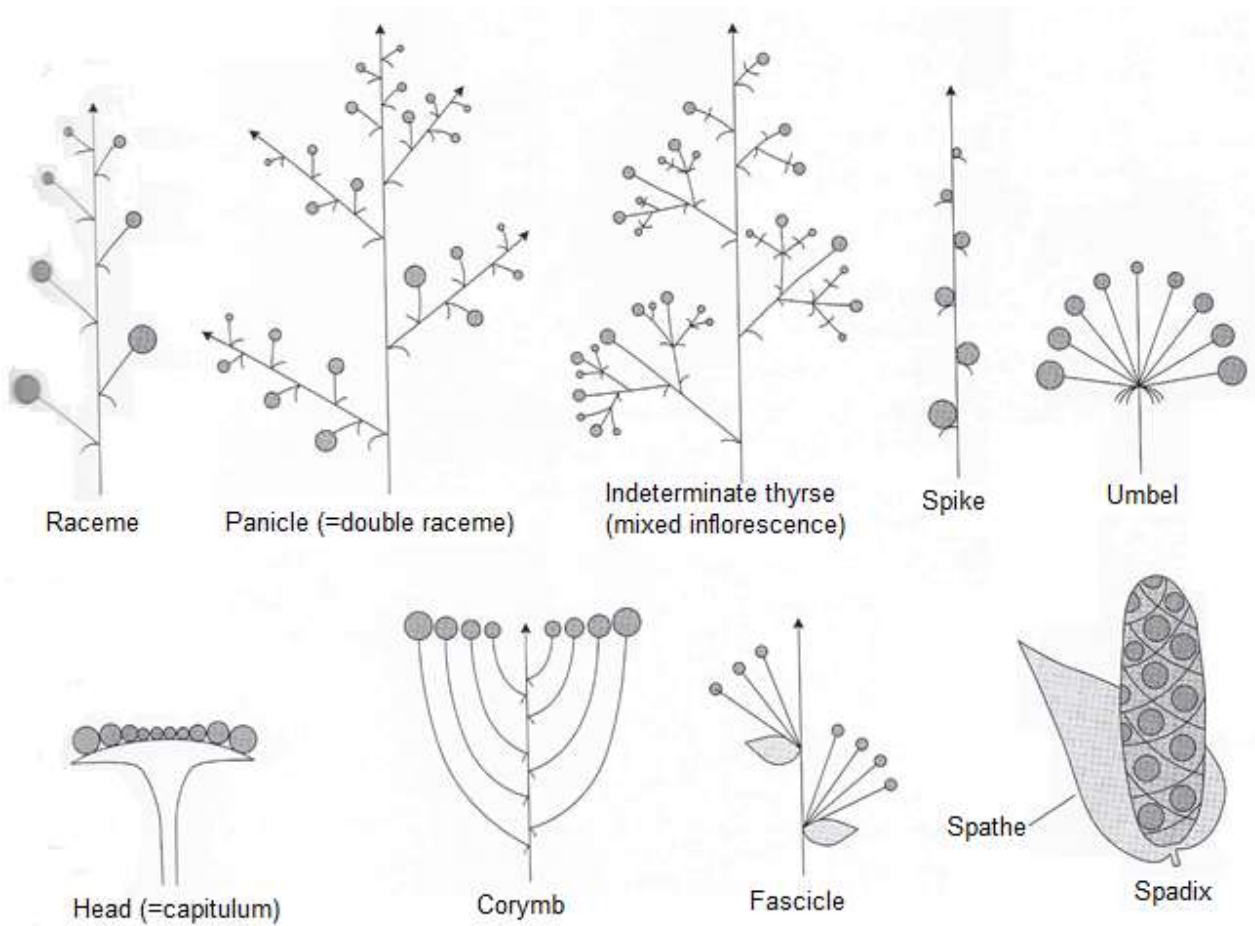


Fig. 14. Some kinds of simple indeterminate inflorescences. The circles represent flowers; their size indicates the sequence of opening

Between determine inflorescences we indicate (fig.15)

raceme-like cyme (*Anemonella*)

helicoid cyme (*Echium, Myosotis*)

scorpid cyme (*Drosera*)

cyme (Caryophyllaceae)

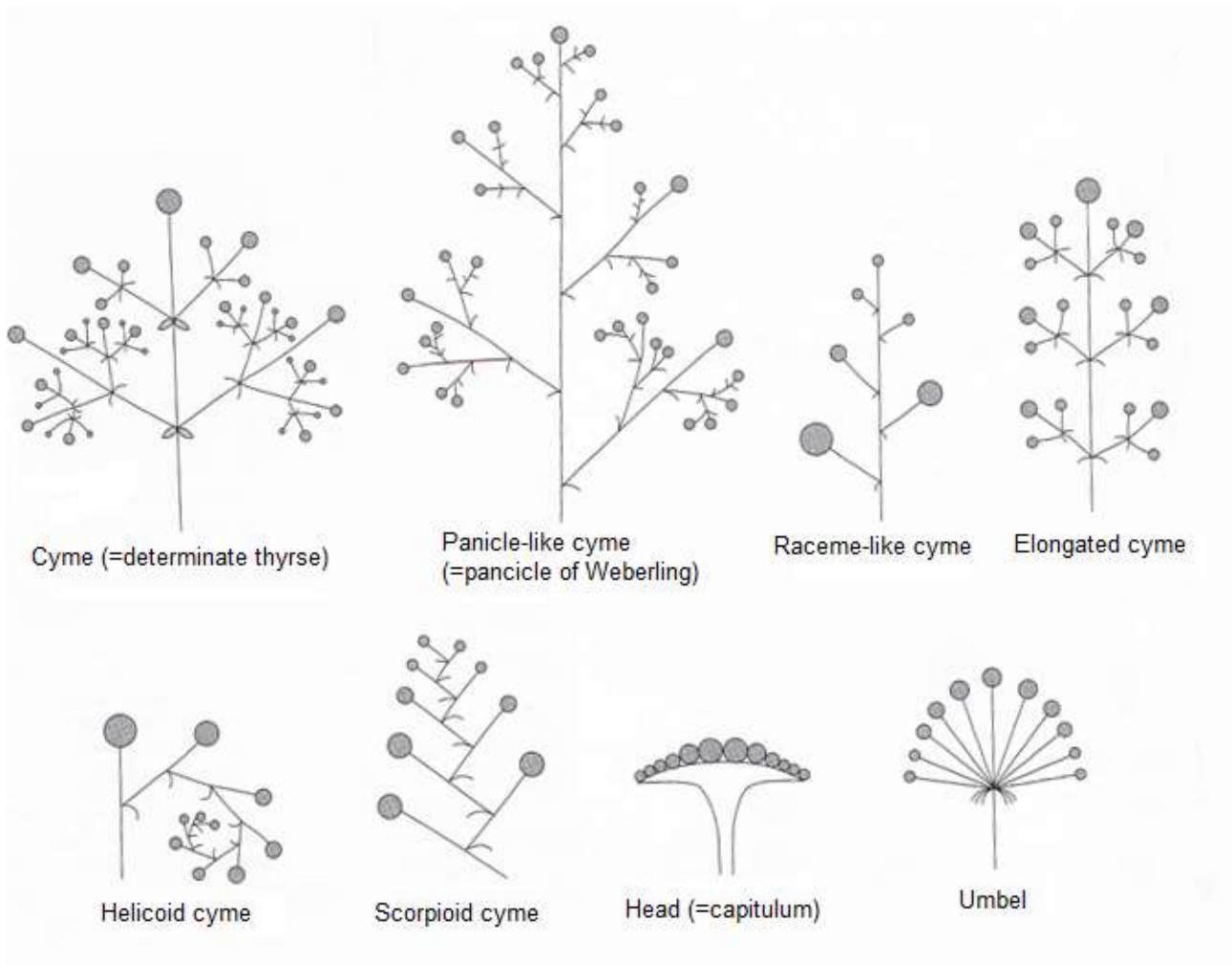


Fig.15. Some kinds of determinate inflorescences. The circles represent flowers; their size indicates the sequence of opening.

Questions

1. What are inflorescences? Name its biological significant.
2. What are types of inflorescences?
3. Name the main types of indeterminate inflorescences.
4. Name the main types of determinate inflorescences.

Fruits

Task

1. Examine the offer material
2. Sketch and designate:

- types of fruits

A fruit is a matured ovary along with fused accessory structures. Here is artificial system of descriptive fruit terms, based on classification of Gray. It is based on the texture of pericarp or fruit wall (fleshy, dry or hard), the pattern of dehiscence or indehiscence (type of fruit opening, or lack thereof), the shape and size of fruit, and carpel and ovule number.

Simple fruits (from single flower) are divided into two category:

- - formed from a single carpel or several fused carpels
- - develop from several separate carpels of a single gynoecium (aggregate fruits).

For example, the fruit of *Magnolia* (Magnoliaceae) is an aggregate of follicles, fruit of *Rubus* (blackberry, Rosaceae) – an aggregate of drups. If the fruit is the product of the gynoecia of several closely clustered flowers, it is termed a multiple fruit. For example, the fruit of *Morus* (mulberry, Moraceae) is multiple of drups, the fruit of *Platanus* (sycamore, Platanaceae) a multiple of achenes.

There are such types of fruits (fig.16,17):

- **achene** – small, indehiscent, dry fruit with a thin and close-fitting wall, surrounding a single seed, includes the cypsela (*Carex*, *Fragaria*, *Helianthus*, *Ranunculus*)
- **berry** – an indehiscent, fleshy fruit with one or a few to many seeds (*Citrus*, *Cucurbita*, *Vitis*)
- **capsule** – a dry to (rarely) fleshy fruit from a two-to many-carpellate gynoecium, that opens in various ways to release the seeds (*Aesculus*, *Allium*, *Ipomoea*, *Papaver*)
- **caryopsis** (=grain) – a small indehiscent, dry fruit with a thin wall surrounding and more or less fused to a single seed (Poaceae)
- **dehiscent drupe** – a fruit with a dry fibrous to fleshy or leathery outer husk that early to tardily breaks apart (or open), exposing one or more nutlike pits, enclosing the seeds (*Rhamnus*, *Carya*)

COMMON TYPES OF FRUITS AND SEEDS

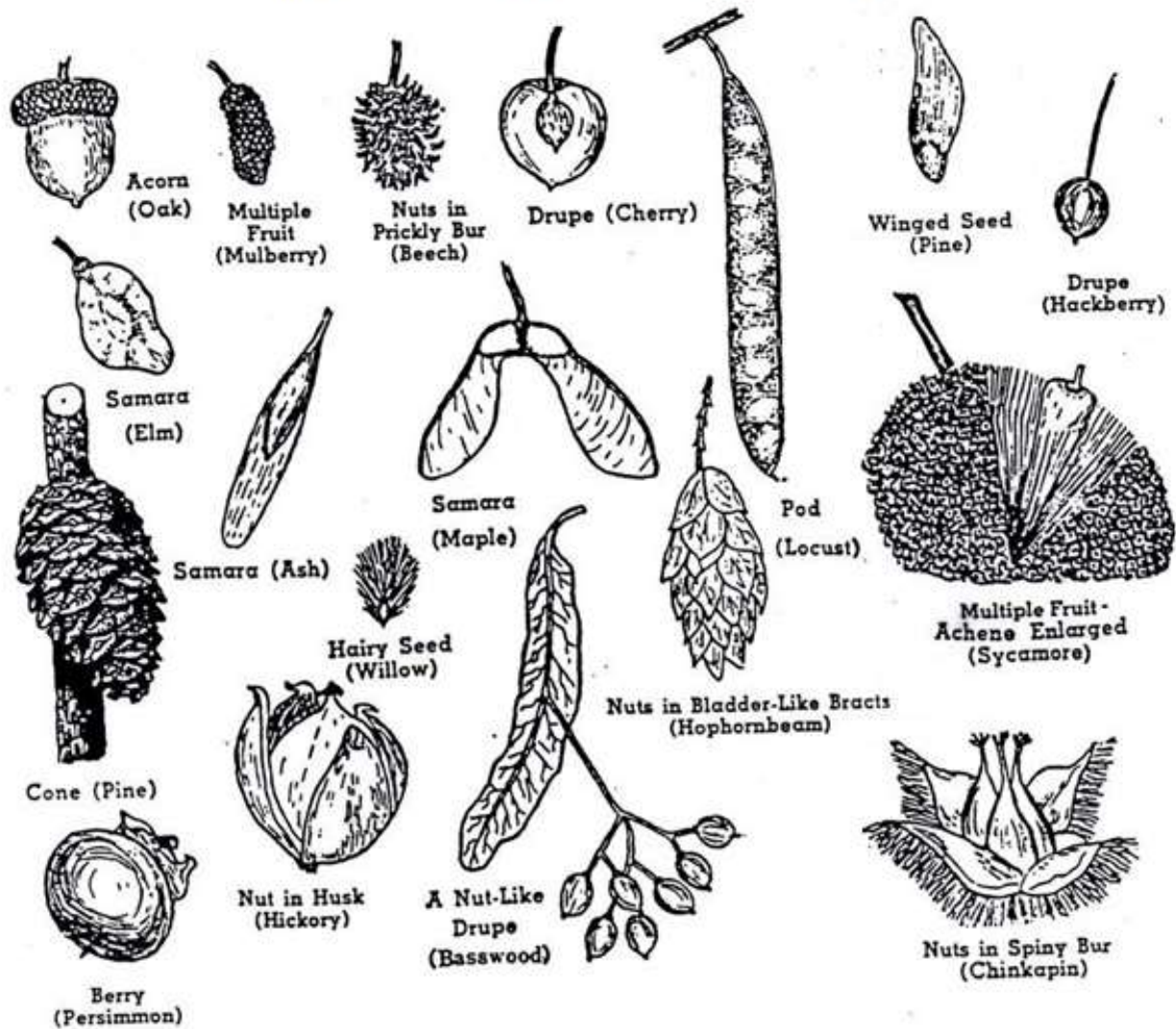


Fig.16. Common types of fruits and seeds

- **drupe** – an indehiscent fleshy fruit, in which the outer part is more or less soft and the center contains one or more hard pits (**pyrenes**), including seeds (*Cocos*, *Juglans*, *Rubus*)
- **follicle** – a dry to (rarely) fleshy fruit derived from a single carpel, that opens along a single longitudinal suture, the seeds may be arillate or with a fleshy testa (*Aquilegia*, *Magnolia*, *Paeonia*)
- **indehiscent pod** – an indehiscent, fairly dry fruit with few to many seeds (*Medicago*)

- **legume** – a dry fruit, derived from a single carpel, that opens along \pm two longitudinal sutures (many Fabaceae)
- **loment** – a dry fruit, derived from a single carpel, that breaks transversely into one-seed segments (*Sophora*)
- **nut** – a fairly large, indehiscent, dry fruit with a thick and bony wall, surrounding a single seed (*Corylus*, *Fagus*, *Quercus*)
- **pome** – an indehiscent fleshy fruit, in which the outer part is soft and the center contains papery or cartilaginous structures, enclosing the seed (*Malus*, Maloideae)
- **samara** – a winged, indehiscent, dry fruit, containing a single seed (*Ailanthus*, *Betula*, *Fraxinus*, *Ulmus*)
- **schizocarp** – a dry to rarely fleshy fruit, derived from a two- to many-carpellate gynoecium, that splits into one-seed segments (**mericarps**). The mericarps may be designed as samara-like, achene-like, drupe-like, etc. (*Acer*, *Daucus*, *Lamium*, *Malva*, *Salvia*)
- **siliqua** – a fruit, derived from a two-carpellate gynoecium, in which the two halves of the fruit split away from persistent partition, include the silicle (many Brassicaceae)
- **urticle** – a small indehiscent dry fruit with a thin wall (bladderlike), that is loose and free from single seed (*Chenopodium*)

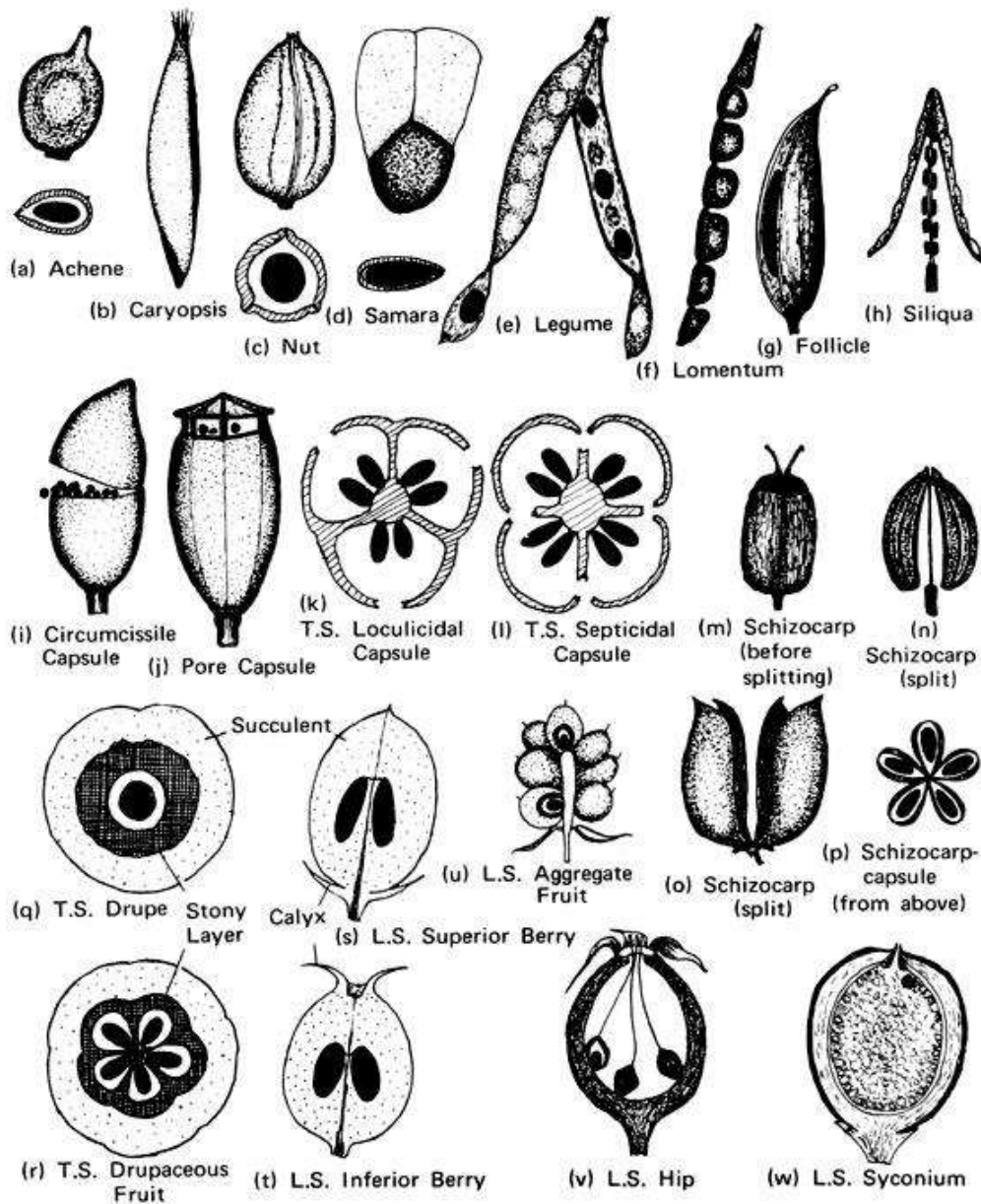


Fig.17. Some types of fruit.

Fruit consists from pericarp and seeds. Pericarp has three slices: exocarp, mesocarp and endocarp. Fruits may be simple and complex. Simple fruits (from single flower) are divided into two category:

- - formed from a single carpel or several fused carpels
- - develop from several separate carpels of a single gynoecium (aggregate fruits).

Classification of fruits is based on type of gynoecium, the texture of pericarp or fruit wall (fleshy, dry or hard), the pattern of dehiscence or indehiscence (type of fruit opening, or lack thereof) (fig.18.).

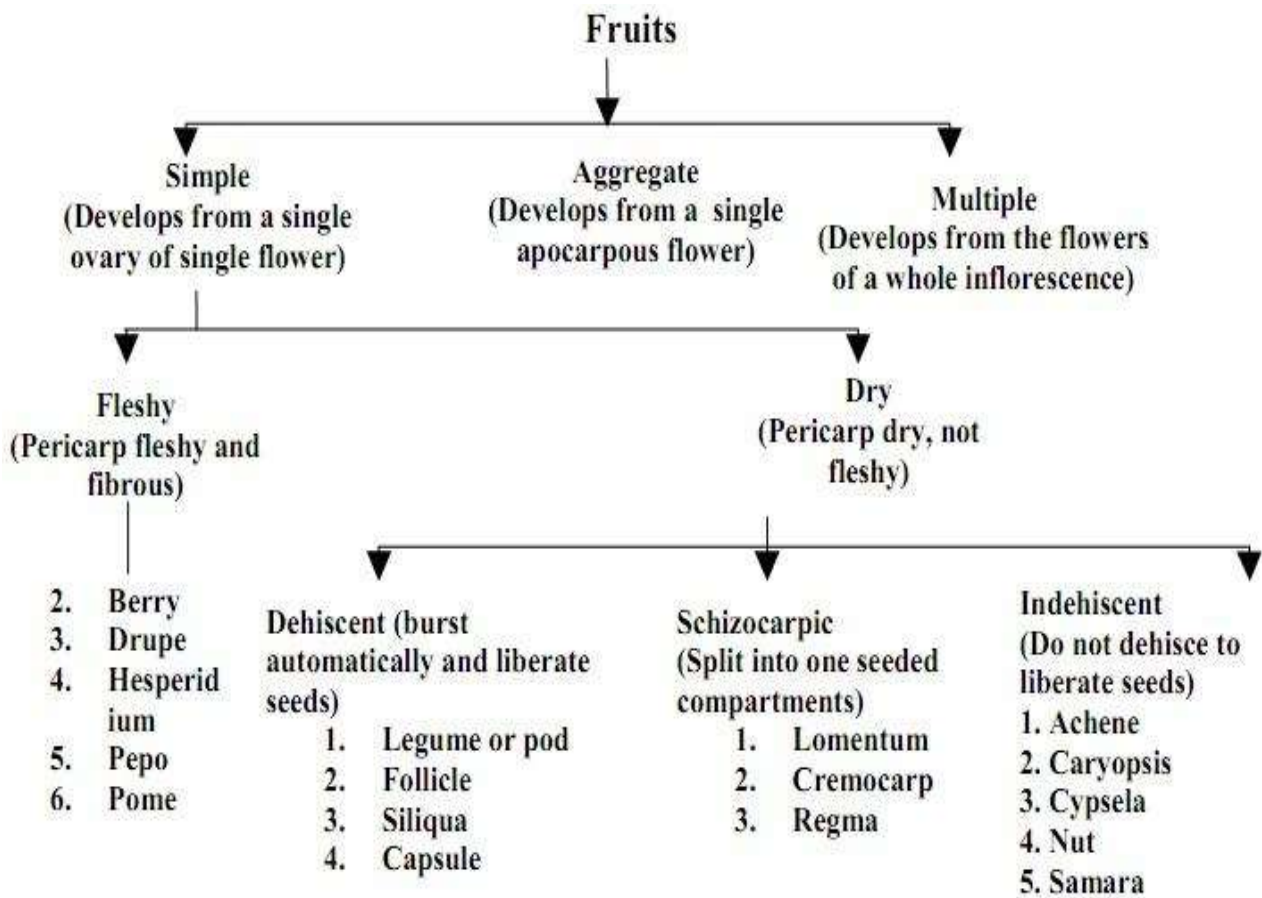


Fig. 18. Classification of fruits.

Dry fruit with the pattern of dehiscence may be:

- **follicle** – a dry to (rarely) fleshy fruit derived from a single carpel, that opens along a single longitudinal suture
- **legume** – a dry fruit, derived from a single carpel, that opens along \pm two longitudinal sutures
- **siliqua** – a fruit, derived from a two-carpellate gynoecium, in which the two halves of the fruit split away from persistent partition, include the **silicle** (many Brassicaceae)
- **capsule** – a dry to (rarely) fleshy fruit from a two-to many-carpellate gynoecium, that opens in various ways to release the seeds (*Aesculus*, *Allium*, *Ipomoea*, *Papaver*, *Petunia*)

- ***schizocarp*** – a dry to rarely fleshy fruit, derived from a two- to many-carpellate gynoecium, that splits into one-seed segments (**mericarps**). The mericarps may be designed as samara-like, achene-like, drupe-like, etc. (*Acer*, *Daucus*, *Lamium*, *Malva*, *Salvia*)

- ***achene-like*** (Apiaceae)

- ***samara-like*** (*Acer*)

- ***nut-like*** (Lamiaceae)

- ***regma*** (Euphorbiaceae)

- ***sterigma*** (Geraniaceae)

Dry apocarp fruit with the pattern of indehiscence may be:

- ***little nut***- little dry fruit with a thick and bony wall, surrounding a single seed (*Nelumbo*, *Thalictrum*)

- ***cynarodium*** – (*Rosa*)

- ***fragaria*** (*Fragaria*)

Dry cenocarp fruit may be:

- ***nut*** - big dry fruit with a thick and bony wall, surrounding a single seed (*Corylus*, *Alnus*)

- ***acorn*** - big dry fruit with a thick and bony wall, surrounding a single seed, which has “cap”(*Quercus*)

- ***achene*** - small, indehiscent, dry fruit with a thin and close-fitting wall, surrounding a single seed (*Urtica*, *Helianthus*)

- ***caryopsis*** (=grain) – a small indehiscent, dry fruit with a thin wall surrounding and more or less fused to a single seed (Poaceae)

- ***samara*** – a winged, indehiscent, dry fruit, containing a single seed (*Ailanthus*, *Betula*, *Fraxinus*, *Ulmus*)

- ***wing nut*** (*Fagopyrum*)

- ***knap-sack*** (*Carex*)

Fruits with fleshy wall may be apocarps and cenocarps. Fleshy apocarps fruits may be

- **drupe** - an indehiscent fleshy fruit, in which the outer part is more or less soft and the center contains one hard pit (**pyrene**), including seeds (*Cocos*, *Juglans*)
- **many drupes** - an indehiscent fleshy fruit, in which the outer part is more or less soft and the center contains more hard pits (**pyrenes**), including seeds (*Rubus*)

Cenocarp fleshy fruits may be **pyrenarium** and **berry**. Pyrenariums may be with one pit (*Cocos*), with many pits (*Sambucus*) and as apple (*Malus*, *Pyrus*, *Cydonia*). Between berries fruits there are:

- **berry** - an indehiscent, fleshy fruit with one or a few to many seeds (*Vitis*)
- **wild orange** –(*Citrus*)
- **pomel-granate** –(*Punica granatum*)
- **pumpkin** – (Cucurbitaceae).

Aggregates may be fleshy too.

Questions

- 1. What is a fruit? What part does it have?
- 2. What is the system of fruit classification?
- 3. Name the apocarps fruits
- 4. Name cenocarps fruit
- 5. Name dry fruit with the pattern of dehiscence and plants, which have such fruits.
- 6. Name dry apocarp fruit with the pattern of indehiscence and plants, which have such fruits.
- 7. Name dry cenocarp fruits and plants, which have such fruits.
- 8. Name fleshy apocarps fruits and plants, which have such fruits.
- 9. Name fleshy cenocarp fruits and plants, which have such fruits

Seeds

Task

1. Examine the offer material
3. Sketch and designate:
 - main parts of *Phaseolus vulgaris* and *Triticum durum* seeds,

- forms of seeds by different agents of disperse

A seed is matured ovule, that contains an embryo and often its nutritive tissues (endosperm, perisperm). The **endosperm** is usually triploid tissue, derived from the union of two cells of the female gametophyte (the polar nuclei) and one sperm nucleus. Endosperm may be *homogenous* (uniform in texture) or *ruminant* (dissected by partitions, that grow inward from the seed coat). The **perisperm** is a specialized, diploid nutritive tissue, derived from the megasporangium.

The seed is surrounded by a **seed coat**, which developed from integuments. The **testa** develops from outer integument and the **tegmen** – from the inner integument.

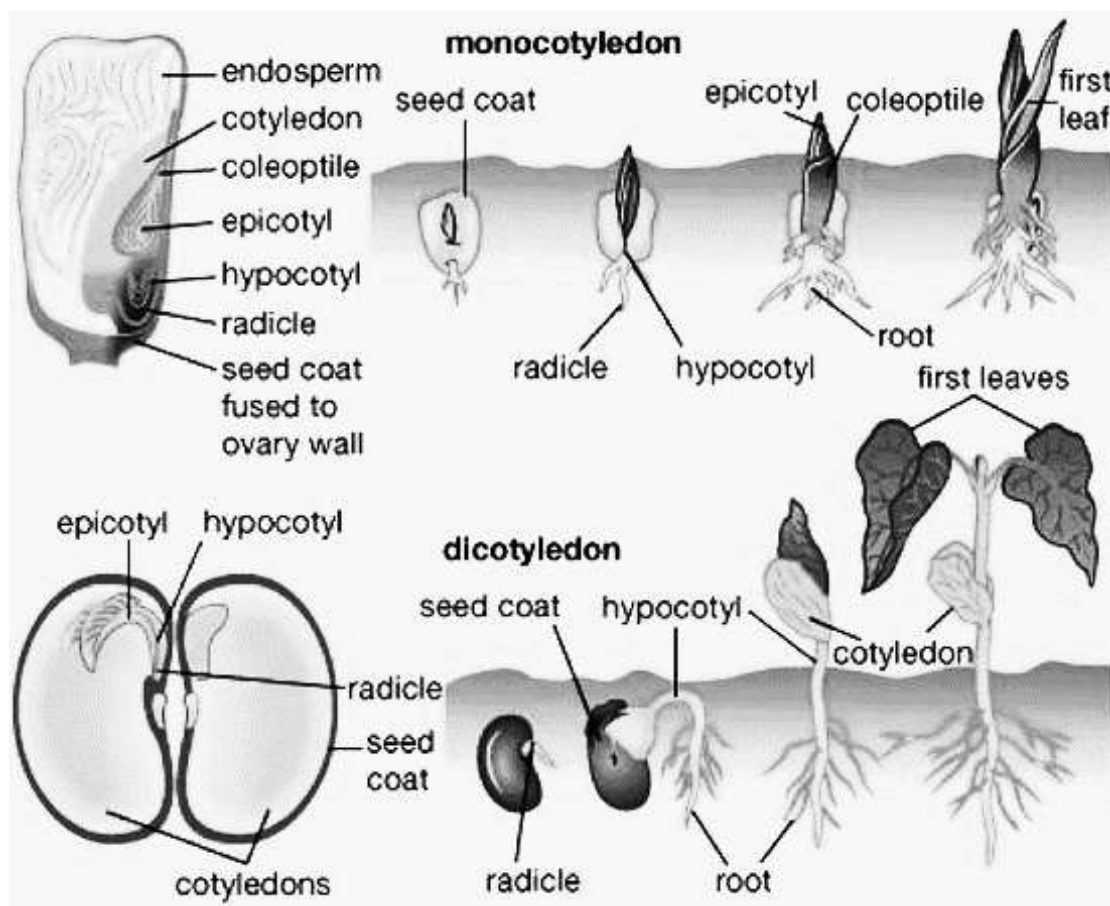


Fig. 19 Seeds and sprouts monocotyledon and dicotyledon plants.

The **embryo** consists of an **epicotyl**, which will develop into shoot; a **radicle**, which will develop into primary root and usually give rise to root system; a **hypocotyl**, which connect the epicotyl and radicle; and one or two **cotyledons**. Some seeds are

associated with a hard to soft, oily to fleshy and often brightly colored structures called an **aril**.

Questions

1. What parts does consist seed?
2. What parts does consist embryo?
3. What is endosperm ?
4. What is perisperm ?

Dispensation of fruit and seeds

Fruits and seeds may be dispersed by a variety of agents and their parts may be modified for those functions.

There are five main types of dispersing: auto-, by wind, by water, by animals, by man. First type includes

To wind dispersal there are belong plants:

- which have a tuft of hairs on the seeds (*Asclepias*) or the wings or hair tufts on the fruits (*Fraxinus, Anemone*), or a wing-like perianth (*Dipterocarpus*). or association of the infructescence with an expanded, wing-like bract (*Tilia*)
- - which have not so perfect devices (*Rumex*)
- - with a tumbleweed habit, when entire plant is blown across the landscape, dispersing its fruits (*Salsola*)

Dispersal by water occurs, when seeds or fruits are small, dry and hard, and may have spines or protections as anchoring structures, a slimy covering, an unwettable surface layer, or low density. Water-dispersed plants have fruits, which can float (*Cocos, Alisma*) or slip on the surface of water or ice (*Phragmites australis*).

- Fruits and seeds, which disperse by animals, have specific devices:
- fish disperse some fleshy fruits or seeds of plants of riversides or inundated areas
- turtles and lizards may disperse fleshy fruits with an odor

- birds _dispersed fruits or seeds, which have attractive edible part
- mammal-dispersed fruits often have a high oil content, are fleshy
- some seeds contain small, nutritious arils and are dispersed by ants.

Besides them there are fruits and seeds, which have different hitching and cling to skin of animals (*Gallium spurium*, *Xanthium*).

Man can disperse fruits and seeds consciously and unconsciously. In second occasion they may be dispersed by transport (*Falcaria vulgaris*), by harvesting machines (*Xanthium strumarium*), with sowing material (*Avena fatua*, *Polygonum aviculare*).

Wind dispersal may be accomplished

- by a tuft of hairs on the seeds (*Asclepias*)
- by the wings or hair tufts on the fruits (*Fraxinus*, *Anemone*)
- by a wing-like perianth (*Dipterocarpus*)
- by association of the infructescence with an expanded, wing-like bract (*Tilia*)
- by a tumbleweed habit, when entire plant is blown across the landscape, dispersing its fruits.

Bird dispersal may be enhanced

- by a colorful, fleshy seed coat (*Magnolia*)
- by fleshy, indehiscent fruits (*Solanum*, *Prunus*)
- by association of the fruits with fleshy accessory structures (*Fragaria*)

Dispersal by weight we can see for heavy fruits that drop from plant land on the ground and stay here.

Dispersal by water occurs, when seeds or fruits are small, dry and hard, and may have spines or protections as anchoring structures, a slimy covering, an unwettable surface layer, or low density.

Dispersal by animals:

- fish disperse some fleshy fruits or seeds of plants of riversides or inundated areas
- turtles and lizards may disperse fleshy fruits with an odor
- birds _dispersed fruits or seeds, which have attractive edible part

- mammal-dispersed fruits often have a high oil content, are fleshy
- some seeds contain small, nutritious arils and are dispersed by ants.

Questions

1. What are the main types of fruits dispensation?
2. What is role of biotical and no biotical factors in dispensation of fruits and seeds?
3. Name the plants which are dispersed by man unconsciously?
4. Name the main types of wind dispersal.
5. Name the main types of dispersal by animals and birds.

Dictionary

achene – сім'янка

achene-like - вислоплідник

acorn - жолудь

acuminate apex of leaf plate – гострокінцева верхівка листка

acute base of leaf plate – клиноподібна основа листка

additional root– додатковий корінь

air-roots – повітряні корені

alternate – чергове

assimilative - асимілюючі

attenuate apex of leaf plate – гостра верхівка листка

axillary bud – брунька, розташована у пазусі листка

bell-shaped type of radial connate corollas – дзвіночкоподібний віночок

berry - ягода

branchy type of root system – гілляста коренева система

breathing-roots – дихальні корені (пневматофори)

bulbs over ground - цибулини надземні

cap-shaped type of radial connate corollas – ковпачкоподібний віночок

capsule – коробочка

caryopsis (=grain) – зернівка

catching leaves of plant - ловчі листки

ciliary margin – війчастий край

climbing sprout – лазаюче стебло

clutching sprout – чіпке стебло

cordate base of leaf plate – серцеподібна основа листка

corumb - щиток

creeping sprout – повзуче стебло

crenate margin – городчастий край

суге –цимозне суцвіття

synarodium – цинародій
dehiscent drupe – кістянка, що поділяється на частини
dentate margin – зубчастий край
dichotomic venation – дихотомічне жилкування
drupe – пиренарій, кістянка
elongated cyme - дихазій
emarginate apex of leaf plate – виїмчаста верхівка листка
fascicle – пучок
fibril type of root system – мичкувата коренева система
flower bud – квіткові бруньки
follicle – листянка
fragaria - багатокістянка
funnel-shaped type of radial connate corollas – воронкоподібний віночок
head – голівка, кошик
helicoid cyme – завійка
hollow (grove) margin – виїмчастий край
indehiscent pod – біб, що не відкривається
knar-sack - мішечок
lateral root – бічний корінь
leaf bud – вегетативні бруньки
legume – біб
little tendrils for climbing - вусики
lobate base of leaf plate – списоподібна основа листка
loment – біб, що поділяється на частини
lying or spreading sprout – лежаче стебло
main root – головний корінь
many drupes - багатокістянка
mix bud – змішані бруньки
mucronate apex of leaf plate – загострена верхівка листка

naked – not covered by bud scales or stipules
naked – голі бруньки
non alike side base of leaf plate – нерівнобока основа
nut - горіх
nut-like – ценобій (4 горішки)
opposite - супротивне
palmate venation – пальчасте жилкування
panicle- волоть
panicle-like суме- волотєподібне цимозне суцвіття
parallel venation – паралельне жилкування
photosynthesis root – фотосинтезуючі корені
phyllocladium – філокладії
phyllodiums – філодії
pinnate venation – перисте жилкування
pivotal type of root system – стрижнева коренева система
polyhedral form of stems – багатогранна форма стебла
pome - яблуко
pomel-granate – гранатина
pulled root – контрактильні (втягуючі) корені
pumpkin – гарбузина
raceme – китиця
raising a little sprout – підведене стебло
regma - регма
rhizome - кореневища
ribbing form of stems – ребриста форма стебла
root as board – дошковидні корені (контрфорси)
root-cone – коренешишки
root-crop - коренеплід
root-hitching – корені-причіпки

roots as post – стовбовидні корені
root-spine – корені-колючки
root-sucker – корені-присоски
rounded apex of leaf plate – округла верхівка
rounded base of leaf plate – округла основа
roundish form of stems – округла форма стебла
sagittate base of leaf plate – стрілоподібна основа
samara – крилатка
samara-like - двокрилатка
saucer-shaped type of radial connate corollas - блюдцеподібний
scales - чешуї
schizocarp – схізокарп
scorpioid cyme – звивина
serrate margin – пилчастий край
silicle - стручечок
silique – стручок
spadis – початок
spike- колос
spines - колючки
spur-shaped type of bilateral connate corollas – шпористий віночок
sterigma - стеригма
stilts-roots – ходульні корені
stolon or runner- столони або вуса
straight sprout – прямостояче стебло
straw – соломину
terminal – верхівкові бруньки
tetrahedral form of stems – чотиригранна форма стебла
thorn – захисні (колючки)
thyse - тіс

tongue-shaped type of bilateral connate corollas – язичковий віночок
triquetrous form of stems – тригранна форма стебла
truncate base of leaf plate – усічена основа листка
tuber-bulbs - бульбоцибулини
tubers – бульби
tube-shaped type of radial connate corollas - трубкоподібний
twine sprout - витке стебло (за годинниковою стрілкою або проти неї)
twinning - вусики
two-lips-shaped type of bilateral connate corollas – двогубий віночок
umbel –зонтик
urticle - горішок
water storage – запасуючі
wheel-shaped type of radial connate corollas - колесоподібний
whorled – мутовчасте
wild orange – померанець
wing nut – крилатий горіх
winged form of stems – крилата форма стебла

СЛОВНИК

асимілюючі - assimilative

багатогранна форма стебла - polyhedral form of stems

багатокістянка – fragaria, many drupes

біб - legume

біб, що не відкривається - indehiscent pod

біб, що поділяється на частини - loment

бічний корінь - lateral root

блюдеподібний віночок - saucer-shaped type of radial connate corollas

бульби - tubers

бульбоцибулини - tuber-bulbs

вегетативні бруньки - leaf bud

верхівкові бруньки - terminal buds

виїмчаста верхівка листка - emarginate apex of leaf plate

виїмчастий край листка - hollow (grove) margin

вислоплідник - achene-like

витке стебло (за годинниковою стрілкою або проти неї) - twine sprout

війчастий край - ciliary margin

волотеподібне цимозне суцвіття - panicle-like cyme

волоть - panicle

воронкоподібний віночок - funnel-shaped type of radial connate corollas

вусики - twinning

вусики little tendrils for climbing

гарбузина - pumpkin

гілляста коренева система - branchy type of root system

голі бруньки - naked

голівка, кошик - head

головний корінь - main root

горіх - nut

горішок - urticle
городчастий край листка - crenate margin
гостра верхівка листка - attenuate apex of leaf plate
гострокінцева верхівка листка - acuminate apex of leaf plate
гранатина - pomel-granate
двогубий віночок - two-lips-shaped type of bilateral connate corollas
двокрилатка - samara-like
дзвіночкоподібний віночок - bell-shaped type of radial connate corollas
дихазій - elongated cyme
дихальні корені (пневматофори) - breathing-roots
дихотомічне жилкування - dichotomic venation
додатковий корінь - additional root
дошковидні корені (контрфорси) - root as board
жолудь - acorn
завійка - helicoid cyme
загострена верхівка листка - mucronate apex of leaf plate
запасаючі воду- water storage
захисні (колючки) - thorn
звивина - scorpioid cyme
зернівка - caryopsis (=grain)
змішані бруньки - mix bud
зонтик - umbel
зубчастий край листка dentate margin
квіткова брунька - flower bud
китиця - raceme
кістянка, що поділяється на частини - dehiscent drupe
клиноподібна основа листової пластини - acute base of leaf plate
ковпачкоподібний віночок - cup-shaped type of radial connate corollas
колесоподібний віночок - wheel-shaped type of radial connate corollas

колос - spike
колючки - spines
контракильні (втягуючі) корені - pulled root
кореневище - rhizome
коренеплід - root-crop
коренешишки - root-cone
корені-колючки - root-spine
корені-присоски - root-sucker
корені-причіпки - root-hitching
коробочка - capsule
крилата форма стебла - winged form of stems
крилатий горіх - wing nut
крилатка - samara
лазаюче стебло - climbing sprout
лежаче стебло - lying or spreading sprout
листокорозміщення чергове - alternate
листянка - follicle
ловчі листки - catching leaves of plant
мичкувата коренева система - fibril type of root system
мішечок - knap-sack
мутовчасте - whorled
нерівнобока основа листка - non alike side base of leaf plate
округла верхівка листка - rounded apex of leaf plate
округла основа листка - rounded base of leaf plate
округла форма стебла - roundish form of stems
пазушні бруньки - axillary bud
пальчасте жилкування - palmate venation
паралельне жилкування - parallel venation
перисте жилкування - pinnate venation

пилчастий край листка - serrate margin
пиренарій, кістянка - drupe
підведене стебло - raising a little sprout
повзуче стебло - creeping sprout
повітряні корені - air-roots
померанець - wild orange
початок - spadix
пряmostoяче стебло - straight sprout
пучок - fascicle
ребриста форма стебла - ribbing form of stems
регма - regma
серцеподібна основа листка - cordate base of leaf plate
сім'янка - achene
соломина - straw
списоподібна основа листка - lobate base of leaf plate
стеригма - sterigma
стовбовидні корені - roots as post
столони або вуса - stolon or runner
стрижнева коренева система - pivotal type of root system
стрілоподібна основа листка - sagittate base of leaf plate
стручечок - silicle
стручок - silique
супротивне розміщення листків - opposite
схізокарп - schizocarp
тіс - thyrse
тригранна форма стебла - triquetrous form of stems
трубкоподібний віночок - tube-shaped type of radial connate corollas
усічена основа листка - truncate base of leaf plate
філодії - phyllodiums

філокладії - phyllocladium
фотосинтезуючі корені - photosynthesis root
ходульні корені - stilts-roots
ценобій (4 горішки) - nut-like
цибулини надземні - bulbs over ground
цимозне суцвіття - cyme
цинародій - synarodium
чешуї - scales
чіпке стебло clutching sprout
чотиригранна форма стебла - tetrahedral form of stems
шпористий віночок - spur-shaped type of bilateral connate corollas
щиток - corymb
яблуко - pome
ягода - berry
язичковий віночок - tongue-shaped type of bilateral connate corollas

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