Laboratory work 3

1. The structure of monocot and dicot seeds of plants.
2. The primary and secondary structure of the root, morphological and anatomical structure of the root in relation to function.

1. The structure of monocot and dicot seeds of plants

Material:
Dicot: sprout of Bean.
Monocot: sprout of oats.

Objective:
to investigate the structure of seeds of monocot and dicot plants.

Tasks of work:
to analyze the morphological structure of the seed of dicot plants on the example of beans;
to analyze the anatomical structure of the seed of cereal;

The mature ovule develops into the **seed**. A typical seed contains a **seed coat, cotyledons, endosperm**, and a **single embryo** (Fig.1). Dicots (left) have two cotyledons. Monocots, such as corn (right), have one cotyledon, called the **scutellum**; it channels nutrition to the growing embryo. Both monocot and dicot embryos have a **plumule** that forms the leaves, a **hypocotyl** that forms the stem, and a **radicle** that forms the root. The embryonic axis comprises everything between the plumule and the radicle, not including the cotyledon(s). The seed coat is made up of an outer layer called testa and an inner layer called tegmen. And a seed is attached to the fruit through a structure called **hilum**.

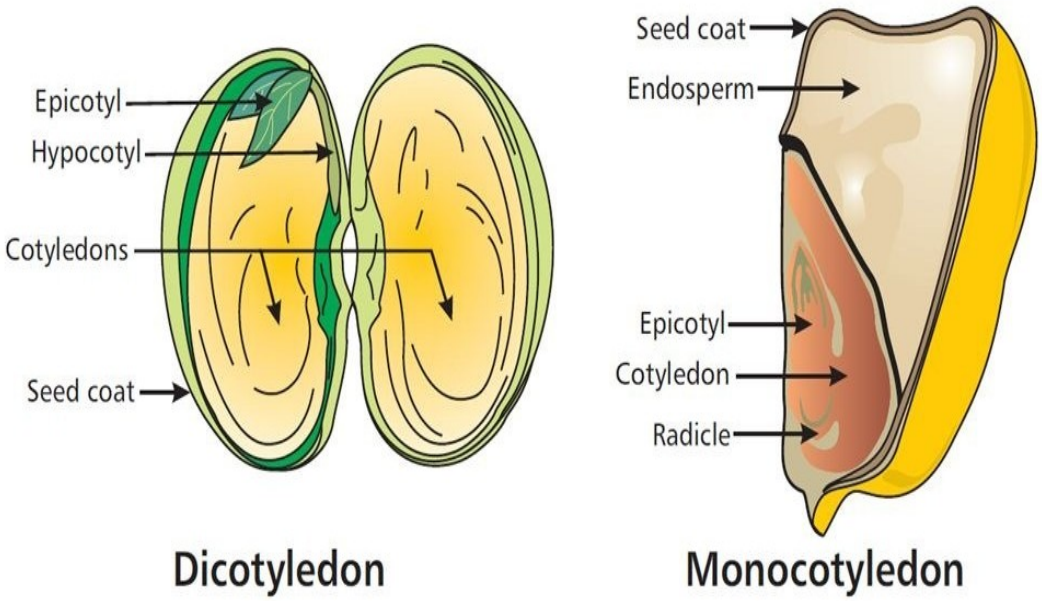
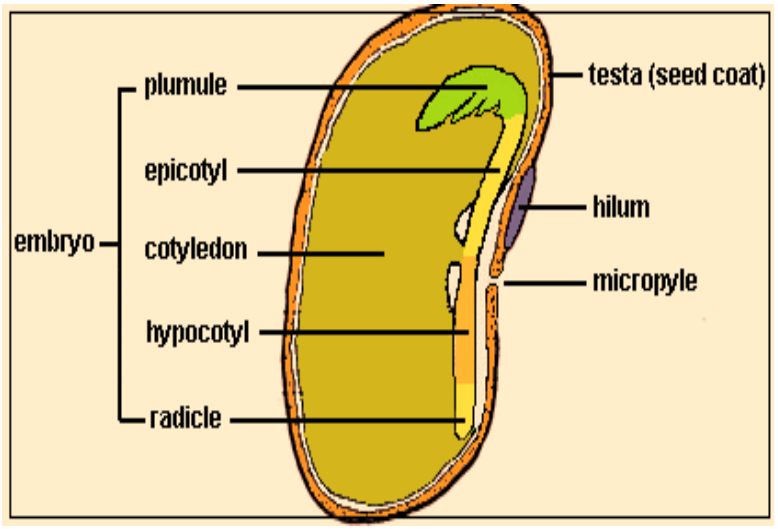
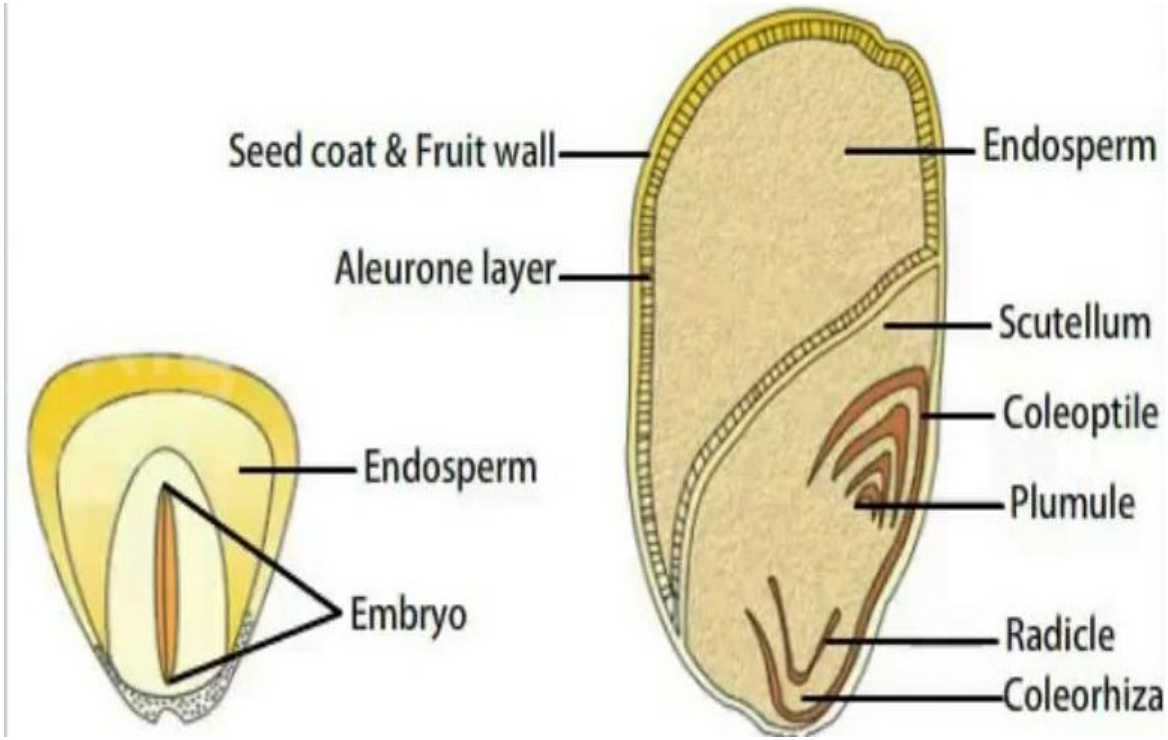


Fig. 1. The structures of dicot and monocot seeds are shown.

Endosperm is the third component of the seeds, others being embryo and seed coat. It is formed by the double fertilization. It consists of reserved food materials. In some plants, as the seeds mature, the endosperm is fully used by the embryo. Such seeds are devoid of endosperm and are called non-endospermous seeds; also called non-albuminous seeds (e.g. peas, beans, and groundnut).



As in dicotyledons, the embryo axis of monocotyledons possesses a shoot tip, plumule, enclosed in a sheath called **coleoptile** and a root tip, radicle, enclosed in **coleorhiza**. In a monocotyledonous seed, the endosperm is covered by a proteinous layer called aleurone layer. The majority of the monocotyledonous seeds are albuminous seeds i.e., they have thick, swollen endosperms for nourishment. The endosperm is not completely consumed during embryo development.



Draw the appearance of the bean seed and label the seed coat, cotyledons, all the organs of the embryo.

Draw the structure of the wheat grain (label the endosperm, the seed coat, all the organs of the embryo.

2. The primary and secondary structure of the root, morphological and anatomical structure of the root in relation to function

Material:
Permanent preparations of the cross-section of the iris root, wheat germ, bean sprouts, oat sprouts.
Permanent preparations of the cross-section of the carrot root, radish root, beet root

Objective:
to investigate the morphological and anatomical root structure of angiosperms.

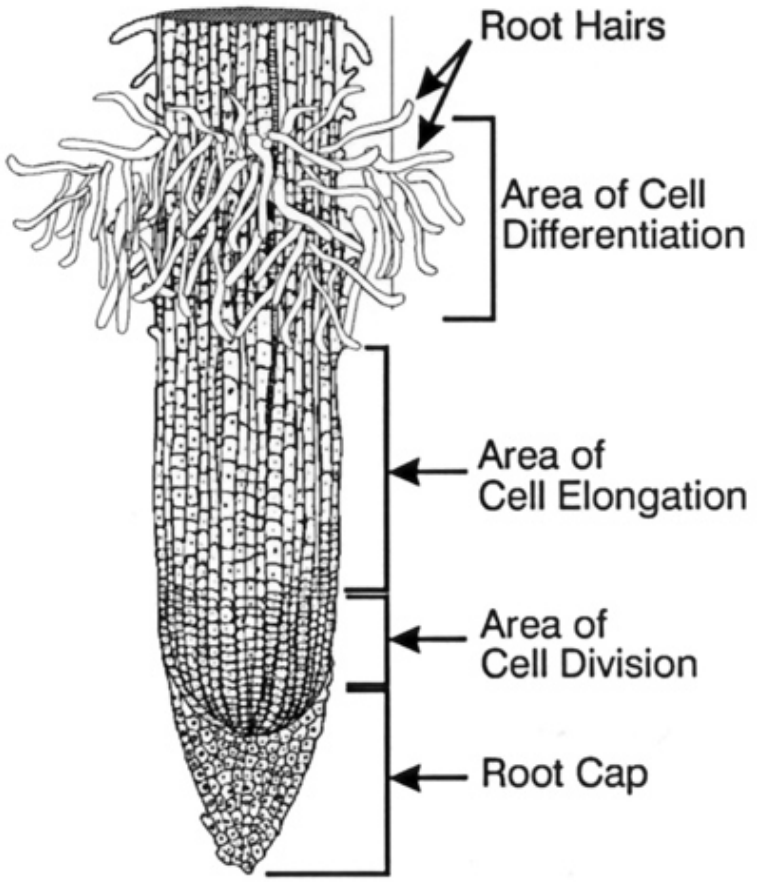
Tasks of work:
To analyze the structure of the zones of the root;
To analyze the primary structure of the root on the example of the root of the iris;
To analyze the secondary structure of the root;
To analyze the phenomenon of polycambiality on the example of beet root.

Functions of roots

1. Anchorage and support.
2. Absorption and conduction. Absorption of water & dissolved minerals, Conduction water/nutrients
3. Storage (surplus sugars, starch)
4. Photosynthesis. Some roots are capable of performing photosynthesis, as in the epiphytic orchids and aerial roots of mangrove trees.
5. Aeration. Plants that grow in stagnant water or other watery places have modified roots called *pneumatophores* to which oxygen from the air diffuses.
6. Movement. In many bulb- and corm-forming plants, *contractile roots* pull the plant downward into the soil where the environment is more stable.
7. Reproduction.

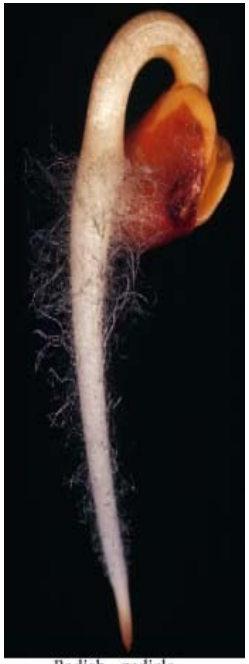
EXTERNAL ANATOMY

- Root cap
- Region of cell division
- Region of elongation
- Region of differentiation or maturation



Take one of the roots of the bean sprouts or oats sprout put on a glass slide.

Draw and label the root structure - Root cap, Region of cell division, Region of elongation and Region of differentiation or maturation.

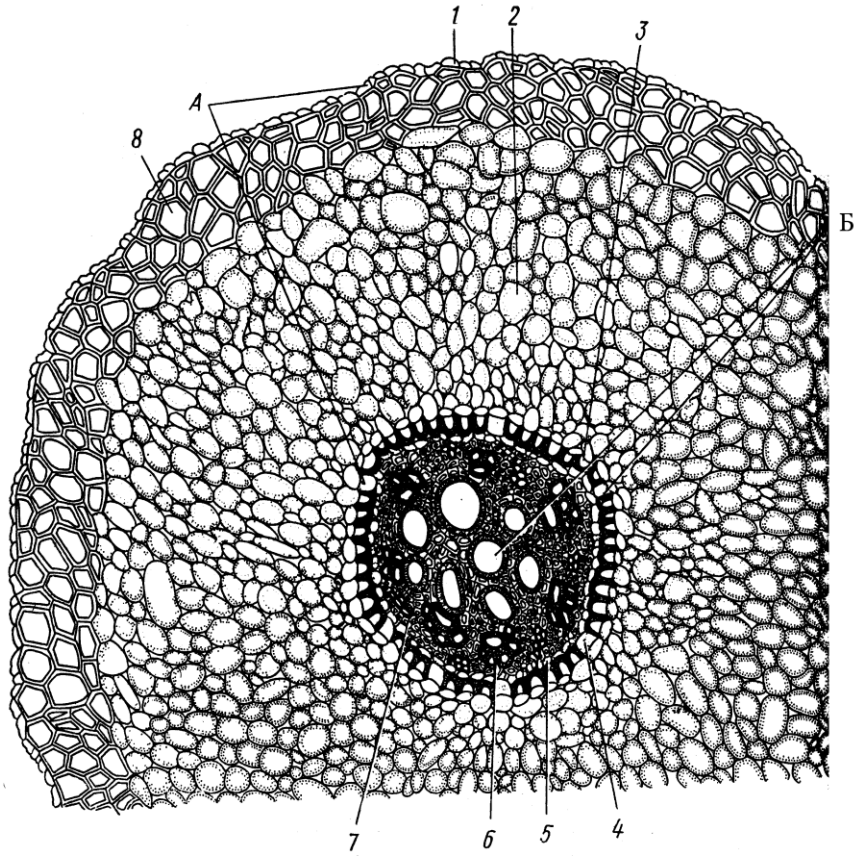


Radish - radicle

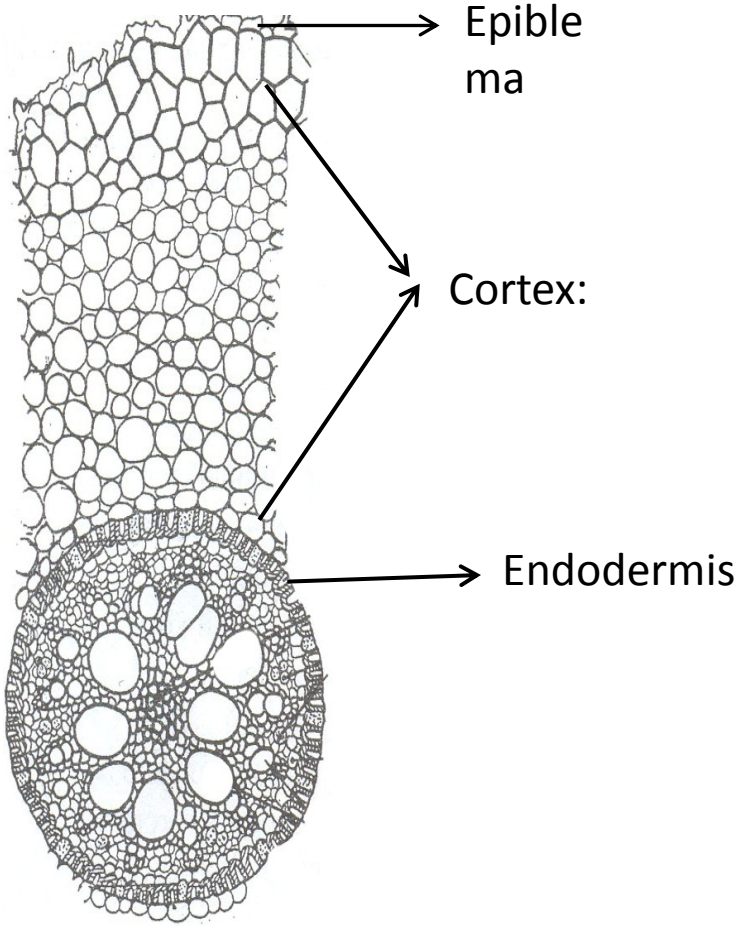
Monocot Root in Cross Section

Draw and label anatomical structure of the root of the iris (Epiblema, Cortex, Endodermis).

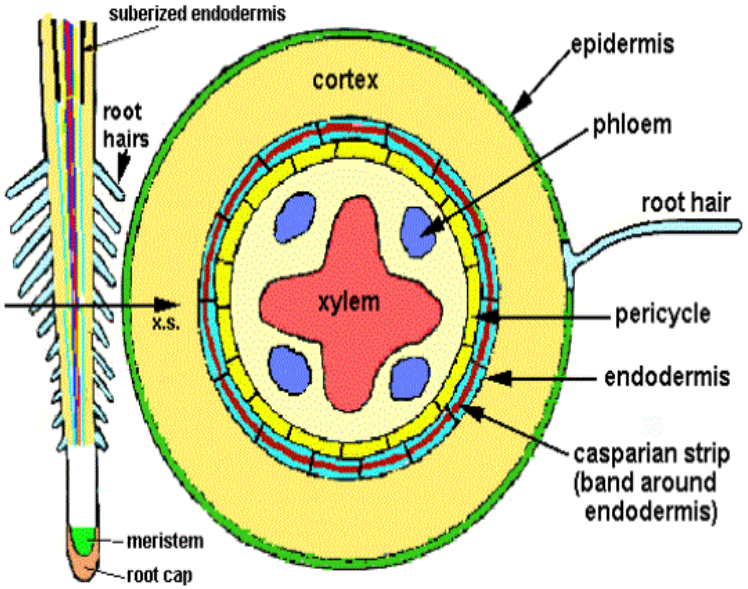
1 - epiblema; 2 - parenchyma of the cortex; 3 - endoderm; 4 - passage cells; 5 - pericycle; 6 - xylem; 7 - phloem; 8 - exodermis



Root of the iris.



Dicot Root in Cross Section



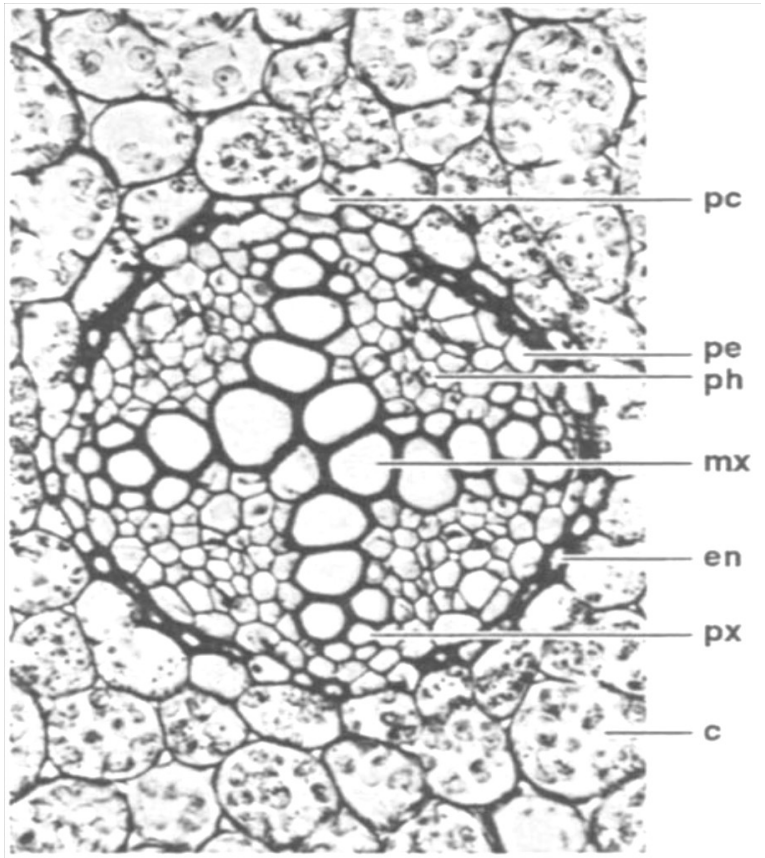
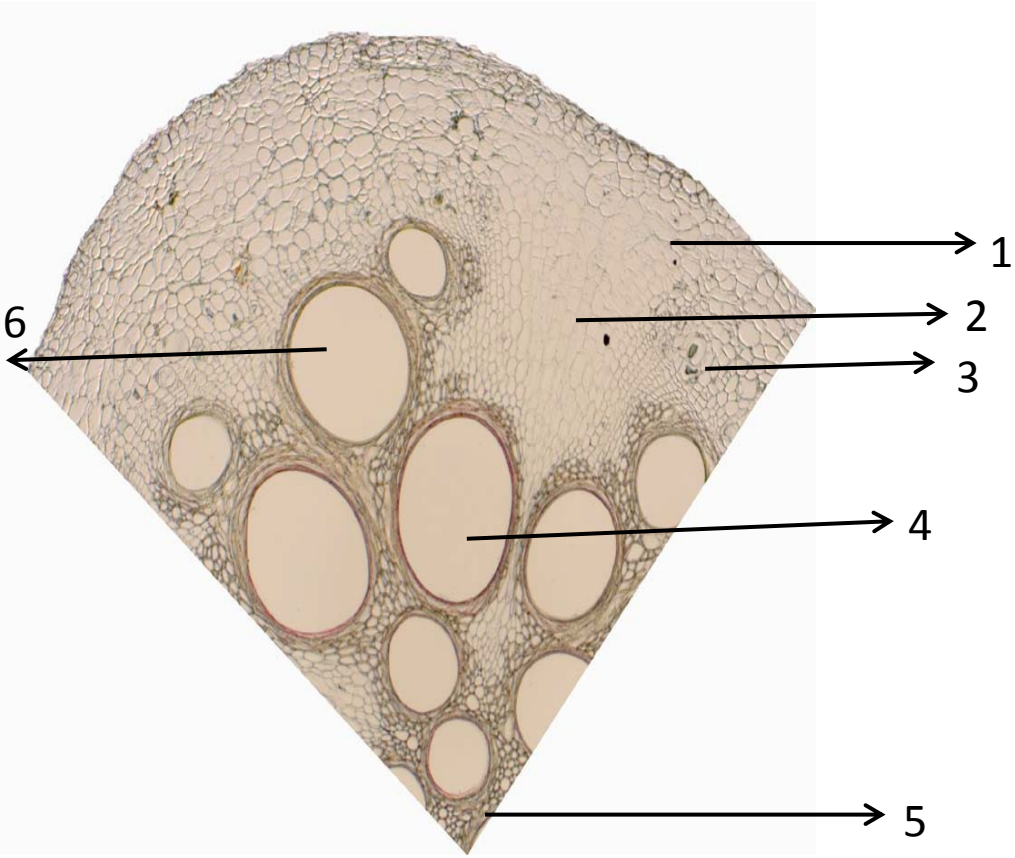


FIGURE 3.25 Transverse section of root of *Ranunculus repens* (Ranunculaceae). Abbreviation cortex; en, endodermis; mx, metaxylem; pc, passage cell; pe, pericycle; ph, phloem; px, protoxylem.

SECONDARY GROWTH IN DICOT ROOTS



Cross-section of pumpkin root: 1 - parenchyma;
2 - rays ; 3 - phloem; 4 - secondary xylem; 5 - primary xylem;
6 - cambium

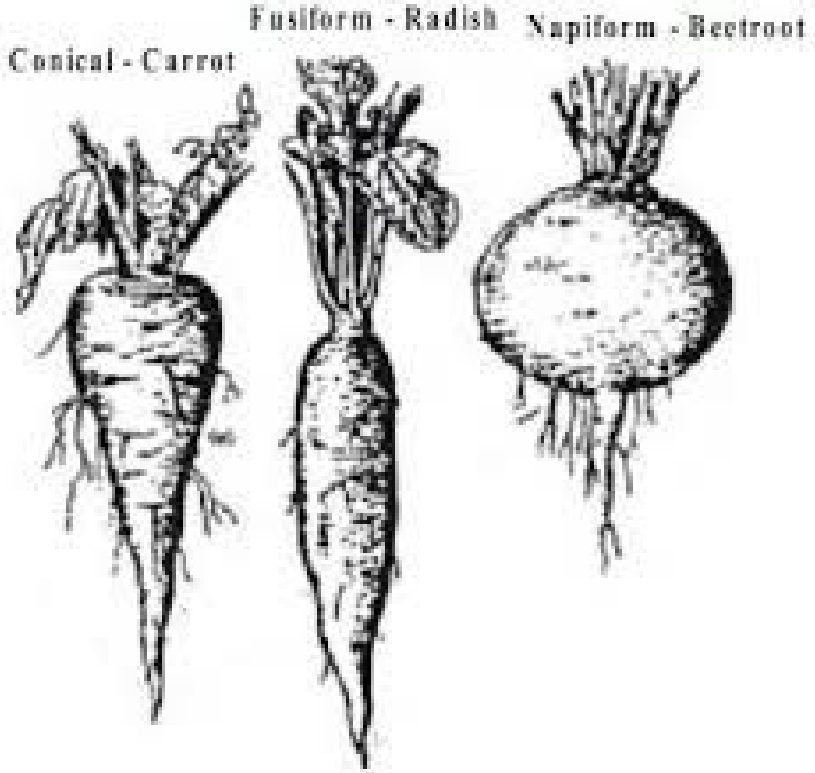
The roots of gymnosperms and most dicotyledonous undergo secondary growth. However, the roots of extant vascular cryptogams and most monocotyledons do not show any secondary growth; they remain entirely primary throughout their life. The tissues involved in secondary growth are lateral meristem i.e., vascular cambium and cork cambium.

SPECIALIZED ROOTS

Storage – thickened roots which contain large amount of stored food (starch or carbohydrates) or sometimes water to survive cold or dry seasons.

Fusiform roots : These root are thicker in the middle and tapered on both ends. In this type of roots both hypocotyl and root help in storage of food. ex: Radish.

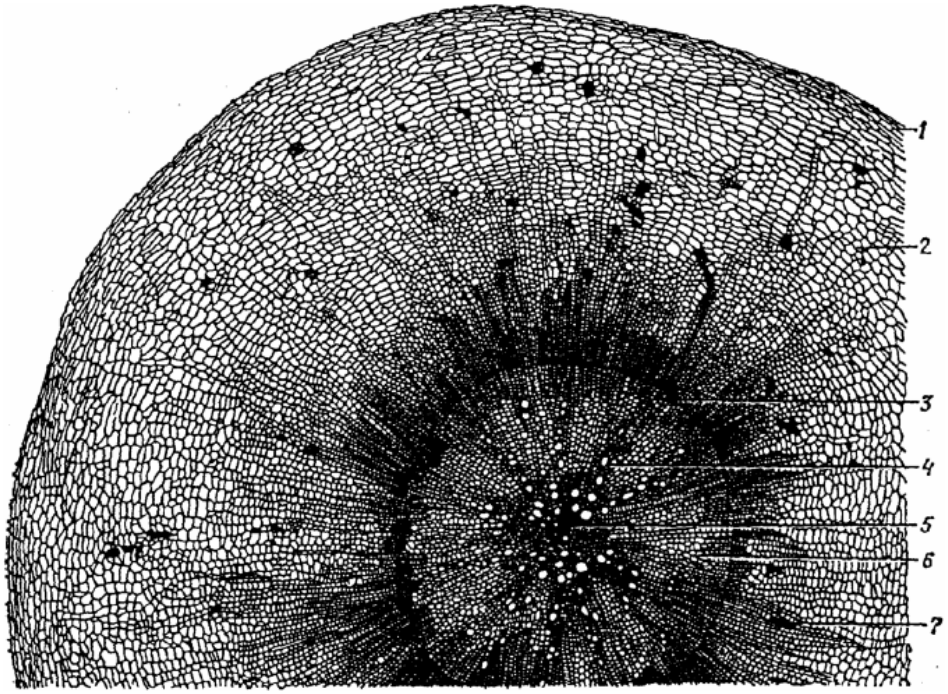
Conical roots : These roots are thicker at their upper side and tapering at basal end. ex: Carrot.



Napiform : These roots become swollen and spherical at upper end and tapered like a thread at their lower end. ex: Turnip

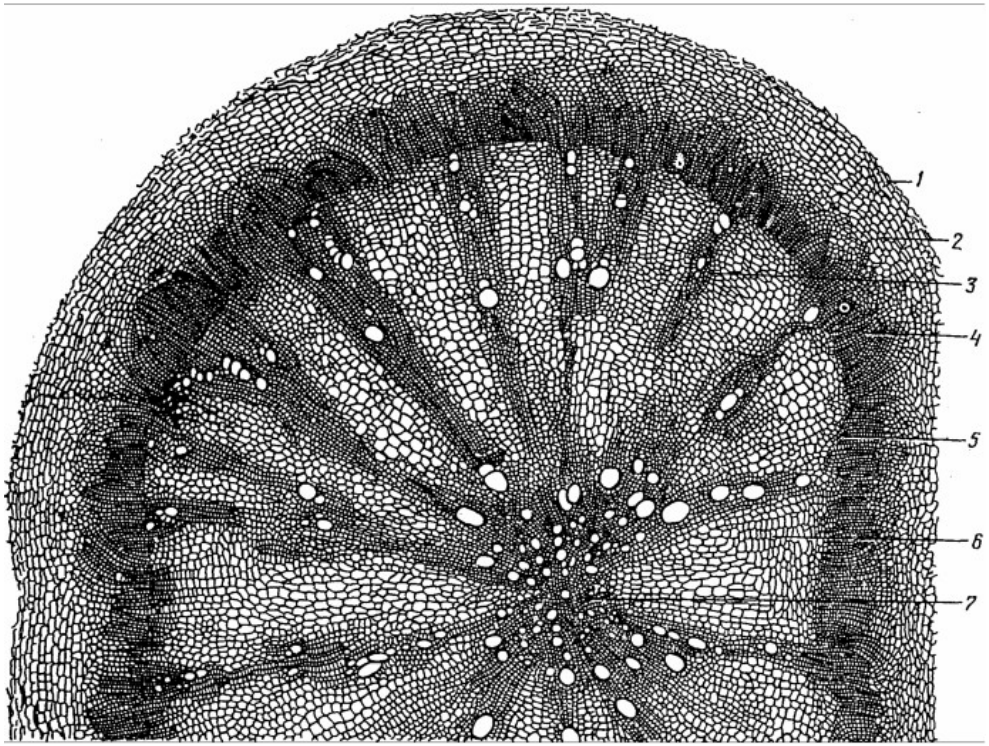
Draw root diagrams of cross-section of monocambial root of carrot, radish, beet root. Label primary and secondary xylem, rays, cambium, phloem, secondary parenchyma, periderm.

Secondary structure of carrot root (*Daucus carota*)



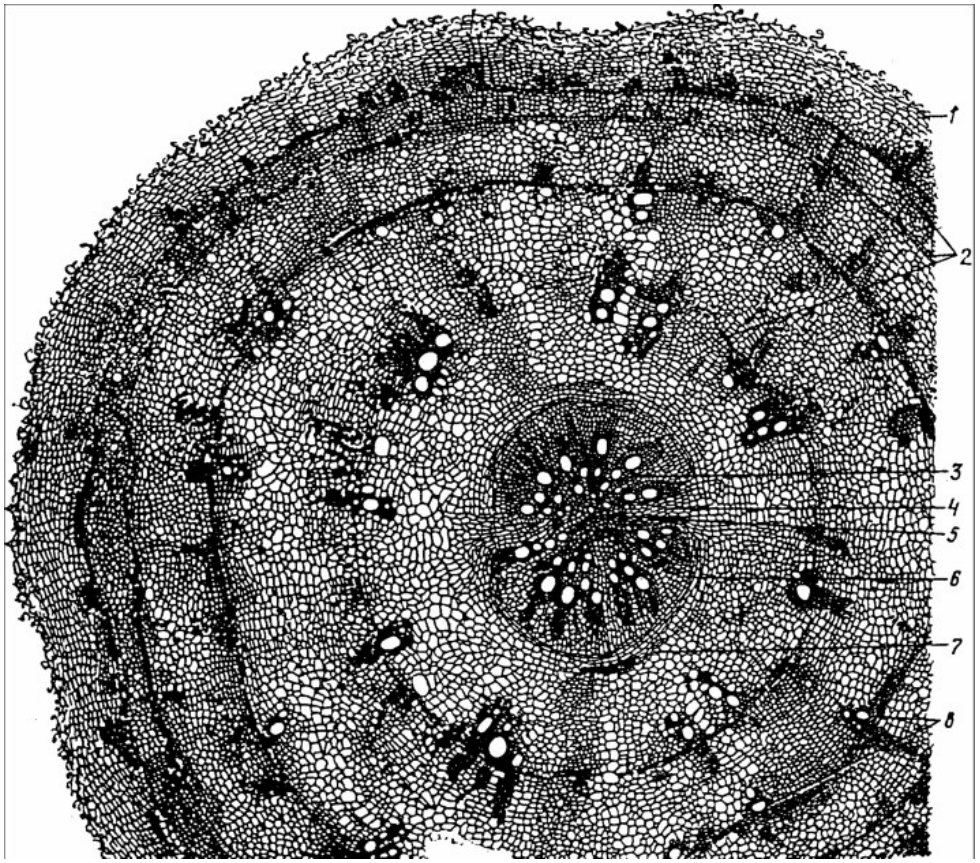
1 - cork; 2 - parenchyma of the secondary cortex; 3 - cambial zone; 4 - secondary xylem; 5 - primary xylem; 6 - ray; 7 - primary and secondary phloem

Secondary structure of radish root (*Raphanus sativus*)



1 - cork; 2 - parenchyma of the secondary cortex; 3 - secondary xylem; 4 - primary and secondary phloem; 5 - cambial zone; 6 – rady; 7 - primary xylem

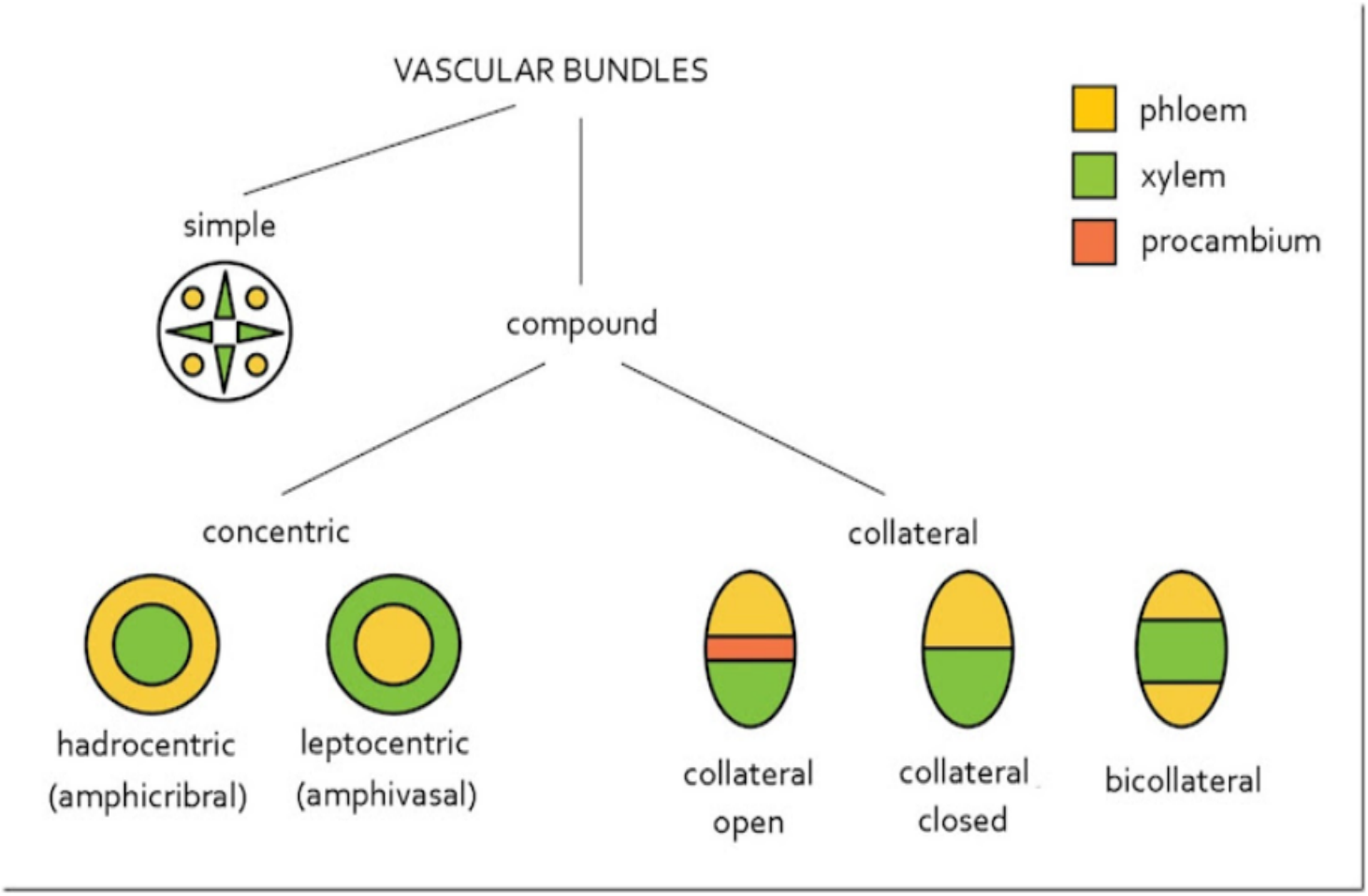
The structure of the polycambial beet root (*Beta vulgaris*)



1- dermal tissue ; 2 - additional cambium layers; 3 - secondary xylem; 4 - ray; 5 - primary xylem; 6 - cambial zone; 7 - primary and secondary phloem; 8 - collateral vascular bundle

Types of Vascular Bundles in Plants

In the primary structure of stem, root and leaves, the conductive tissue xylem and phloem are grouped together. A group of xylem and phloem forms a vascular bundle. The different types of vascular bundles met within plants are:



Monocots

One cotyledon

Veins usually parallel

Vascular bundles usually complexly arranged

Fibrous root system

Floral parts usually in multiples of three

Embryos	Leaf venation	Stems	Roots	Flowers

Dicots

Two cotyledons

Veins usually netlike

Vascular bundles usually arranged in ring

Taproot usually present

Floral parts usually in multiples of four or five