

Definition of Stomata

The stomata are apertures in the epidermis, each bounded by two guard cells. In Greek, *stoma* means “mouth”, and the term is often used with reference to the stomatal pore only. Esau (1965, p. 158) uses the term stoma to include the guard cells and the pore between them, and we will use her definition. The plural of stoma is *stomata*. There is no such word as “stomates”.

Stomata occur in [vascular plants](#). Vascular plants include the lower vascular plants such as [horsetails](#) (*Equisetum*), [ferns](#) (class Filicinae), [gymnosperms](#), and [angiosperms](#). As noted before, the angiosperms are the flowering plants and this group consists of the two large classes: Monocotyledoneae (monocotyledons) and Dicotyledoneae (dicotyledons) (Fernald, 1950).

By changing their shape, the guard cells control the size of the stomatal aperture. The aperture leads into a substomatal [intercellular space](#), the substomatal chamber, which is continuous with the [intercellular spaces](#) in the [mesophyll](#). In many plants, two or more cells adjacent to the guard cells appear to be associated functionally with them and are morphologically distinct from the other epidermal cells. Such cells are called *subsidiary*, or *accessory*, cells (Esau, 1965, p. 158).

The stomata are most common on green aerial parts of plants, particularly the leaves. They can also occur on stems, but less commonly than on leaves. The aerial parts of some chlorophyll-free land plants (*Monotropa*, *Neottia*) and roots have no stomata as a rule, but [rhizomes](#) have such structures (Esau, 1965, p. 158). Stomata occur on some [submerged aquatic plants](#) and not on others. The variously colored petals of flowers often have stomata, sometimes nonfunctional. Fruits also can have stomata. Stomata are found on [stamens](#) and [gynoecia](#).

Stomata can be distributed in the following ways on the two sides of a leaf:

An *amphistomatous* leaf has stomata on both surfaces. Most plants have such a distribution.

A *hypostomatous* leaf has stomata only on the lower surface. Many tree species are characterized by having hypostomatous leaves, such as [horse chestnut](#) (*Aesculus hippocastanum*) and basswood (*Tilia europaea*) (Meidner and Mansfield, 1968; see their Table 1.1). The leaf of poplar (*Populus* sp.) is an exception. It has stomata on both surfaces and a [petiole](#) that allows the leaf to turn readily in the wind. These adaptations may allow its fast growth rate. The fast growth rate of poplar is one reason it is widely used in [phytoremediation](#) (use of plants to remove pollutants from soil).

An *epistomatous* leaf has stomata only on the upper surface of the leaf. Some floating plants are epistomatous.

A *heterostomatous* leaf has stomata that occur with more than twice the frequency on the abaxial surface than on the adaxial surface. An *isostomatous* leaf has stomata that occur with approximately equal frequencies on both surfaces.

The *stomatal ratio* is the ratio of stomatal frequency on the adaxial surface to that on the abaxial surface.

Stomata: Definition, Types and Functions

Definition of Stomata:

The stomata are minute pores which occur in the epidermis of the plants. Each stoma remains surrounded by two kidneys or bean shaped epidermal cells the guard cells. The stomata may occur on any part of a plant except the roots. The epidermal cells bordering the guard cells are called accessory cells or subsidiary cells.

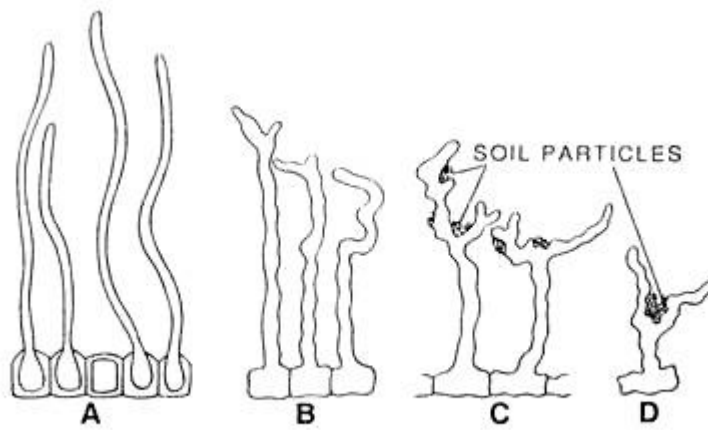


Fig. 37.6. Root hairs, A, grown in water; B, grown in moist soil; C and D, grown in dry soil. (After Schwarz).

Generally the term stoma is applied to the stomatal opening and the guard cells. The guard cells are living and contain chloroplasts in them. They also contain a larger proportion of protoplasm than other epidermal cells. Usually in the leaves of dicotyledons the stomata remain scattered whereas in the leaves of monocotyledons they are arranged in parallel rows.

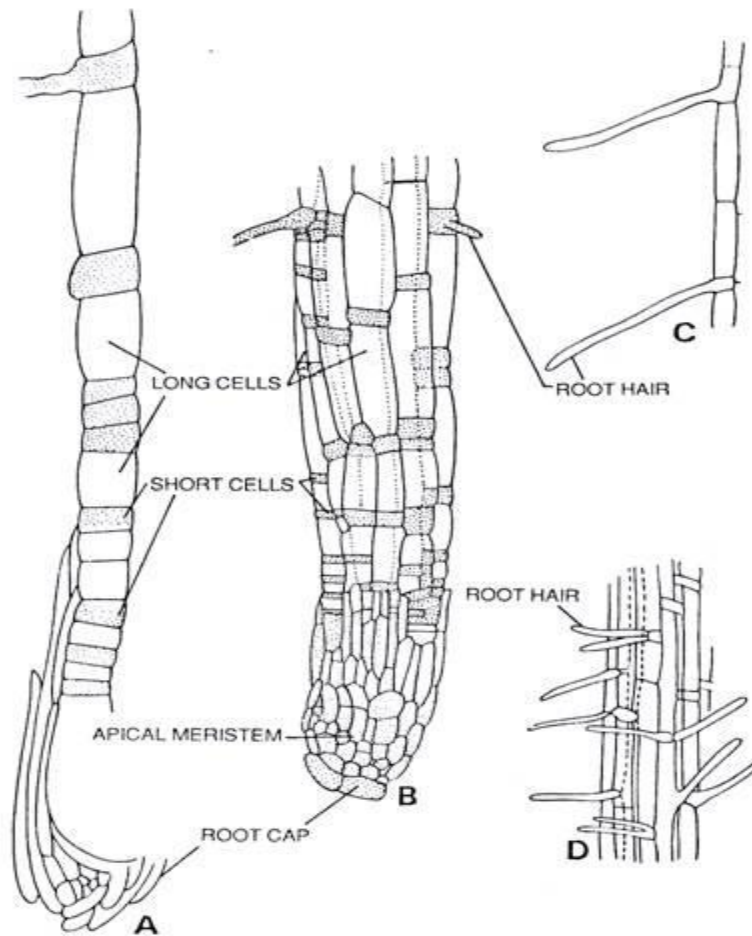
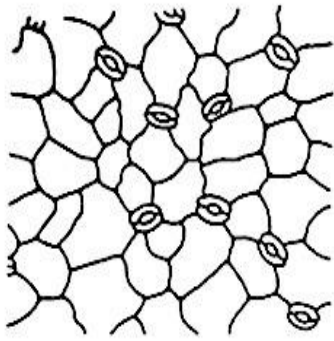


Fig. 37.7. Development of root hair from protruded cells. A,C, in *Cyperus*. B,D, in *Anigozanthos*.

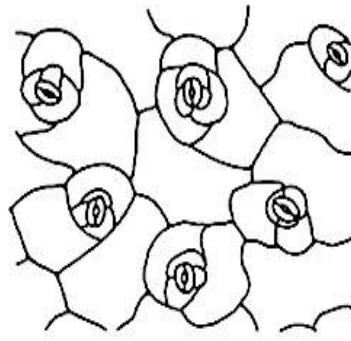
The number of stomata may also range on the surface of a single leaf from a few thousand to hundreds of thousands per square centimetre. Stomata occur on both upper and lower surfaces of leaf, but especially they are confined to the lower surface. In floating leaves Stomata are confined only on the upper surface of the leaf.

Under normal conditions the stomata remain closed in the absence of light or in night or remain open in the presence of light or in day time. Structurally the stomata may be of different types.



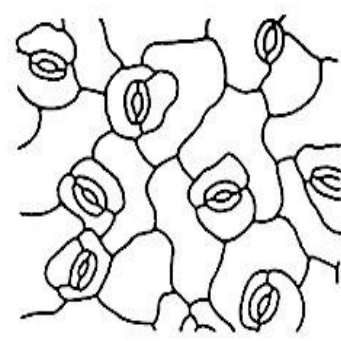
Citrullus – anomocytic

A



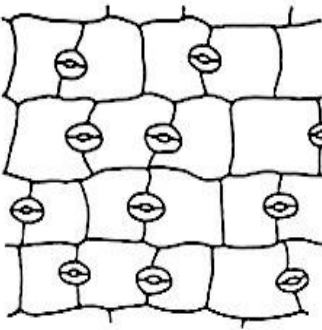
Sedum – anisocytic

B



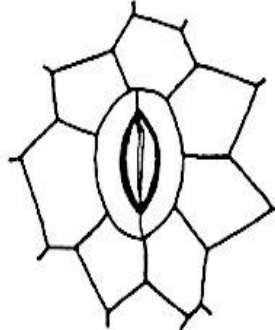
Vigna – paracytic

C



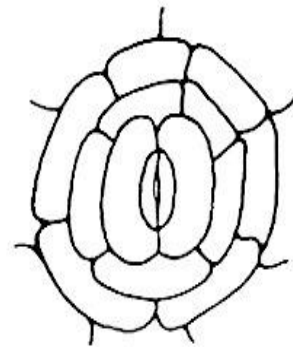
Dianthus – diacytic

D



Lannea – actinocytic

E



Schinopsis – cyclocytic

F

1. Anomocytic (Irregular celled) or Ranunculaceous: In this type, the stomata remains surrounded by limited number of subsidiary cells which are quite alike the remaining epidermal cells.

Example: Ranunculaceae, Malvaceae, Papaveraceae

2. Anisocytic (Unequal celled) or Cruciferous: In this stomata remains surrounded by three subsidiary cells of which one is distinctly smaller than the other two.

Example: *Cruciferaea*, *Solanum*, *Nicotiana* etc.

3. Paracytic (Parallel celled) or Rubiaceous: In this type, the stomata surrounded by two subsidiary cells which are parallel to the longitudinal axis of pore and guard cells.

4. Diacytic (Cross celled) or Caryophyllaceous: In this type, the stomata remains surrounded by a pair of subsidiary cells whose common wall is at right angles to the guard cells.

Example: Acanthacea, Caryophyllaceae

5. Actinocytic: These stomata are surrounded by four or more subsidiary cells, elongated radially to the stomata.

Example: Araceae, Musaceae, Commelinaceae

6. Cyclocytic: The stomata are surrounded by four or more subsidiary cells arranged in a narrow ring around the stoma

Example: Palmae, Pandanus, Cyclanthaceae

7. Graminaceous type: The stomatal guard cells are dumb bell shaped. They are surrounded by subsidiary cells which are lying parallel to the long axis of the pore.

Example: In the members of Poaceae and cyperaceae

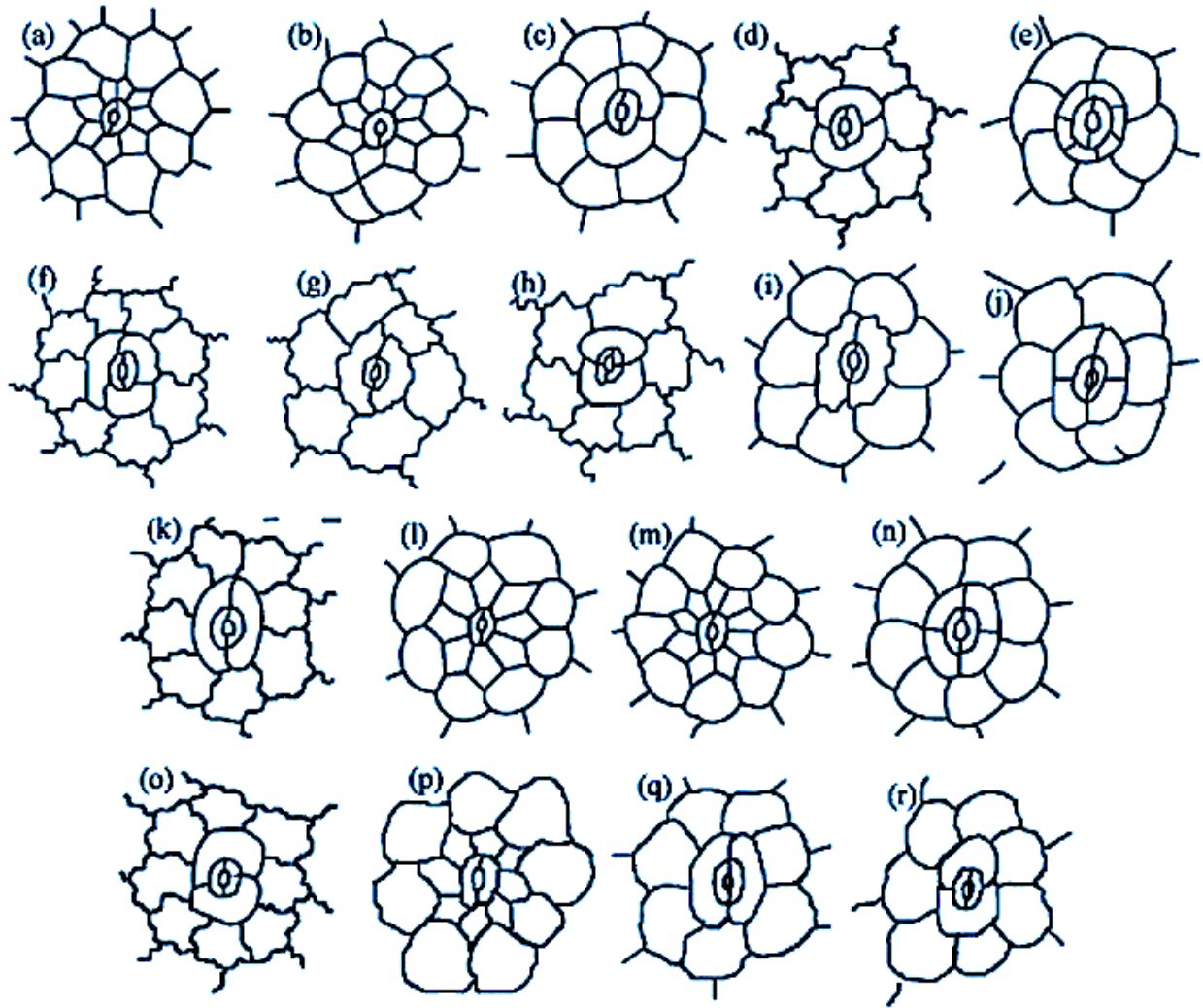


Fig. 1: Leaf surface view of (a) *Coccinia barteri* showing actinocytic stoma, (b) *Coccinia grandis* showing actinocytic stoma, (c) *Citrullus lanatus* showing anisocytic stoma, (d) *Citrullus colocynthis* showing diacytic and cyclocytic stomata, (e) adaxial, (f) abaxial, *Cucumis melo* anisocytic stoma, (g) *Cucumis sativus* showing paracytic stoma, (h) *Lagenaria breviflorus* showing diacytic and paracytic stomata, (i) adaxial, (j) abaxial), *Lagenaria siceraria* showing staurocytic and paracytic stomata, (k) adaxial, (l) abaxial), *Luffa acutangula* actinocytic stoma, (m) *Luffa cylindrica* showing actinocytic and staurocytic stomata, (n) adaxial, (o) abaxial), *Momordica charantia* showing diacytic stoma, (p) *Momordica foetida* showing actinocytic stoma, (q) *Telfairia occidentalis* paracytic stoma and (r) *Trichosanthes cucumerina* showing diacytic stoma