Seed germination

The resumption or revival of growth of the dormant embryo of seed is called seed germination. During this process the embryonic plant is awaking up from the dormant state to the active life. The result of germination is the producing of tiny plant, called seedling.

Conditions necessary for germination are:

- **A. External factors**

1. Water: it plays an important role in the germination of seed. A viable seed, after absorbing some amount of water, will resume various physiological activities. Thereby transfer of soluble food from the cotyledon or the endosperm to the activity growing region of the embryo Due to imbibition of water, the seed coats become soften and burst easily during the growth of the developing embryo.

2. Oxygen: During germination, the seed requires more energy for its growth, thus the rate of respiration becomes high and oxygen is essentially required.

3. Temperature: Most seeds fail to germinate below 5°C and above 45°C. The optimum temperature lies between 25°C- 30°C.

4. Light: Light has variable effect on the germination of seeds. Based on the sensitivity of light, they are divided into three types:

i. Light- sensitive i.e., the germination is favored by light.

ii. Light- hard i.e., the germination is inhibited by light.

iii. Light- indifferent i.e., the germination is not affected by the presence or absence of light.

B. Internal factors

1. Reserve food: Food is absolutely necessary for the normal growth and development of the growing embryo. This comes from cotyledon or endosperm.

2. Growth regulators: Some growth regulators like auxins are developed inside the seed at the time of germination. These are required for the growth of the embryo during germination.

3. Completion of dormancy: Dormancy is a state or condition of inactivity exhibited by many seeds before germination. The period of dormancy varies from plant to plant. It is also a means to overcome the period., unsuitable for a successful germination.

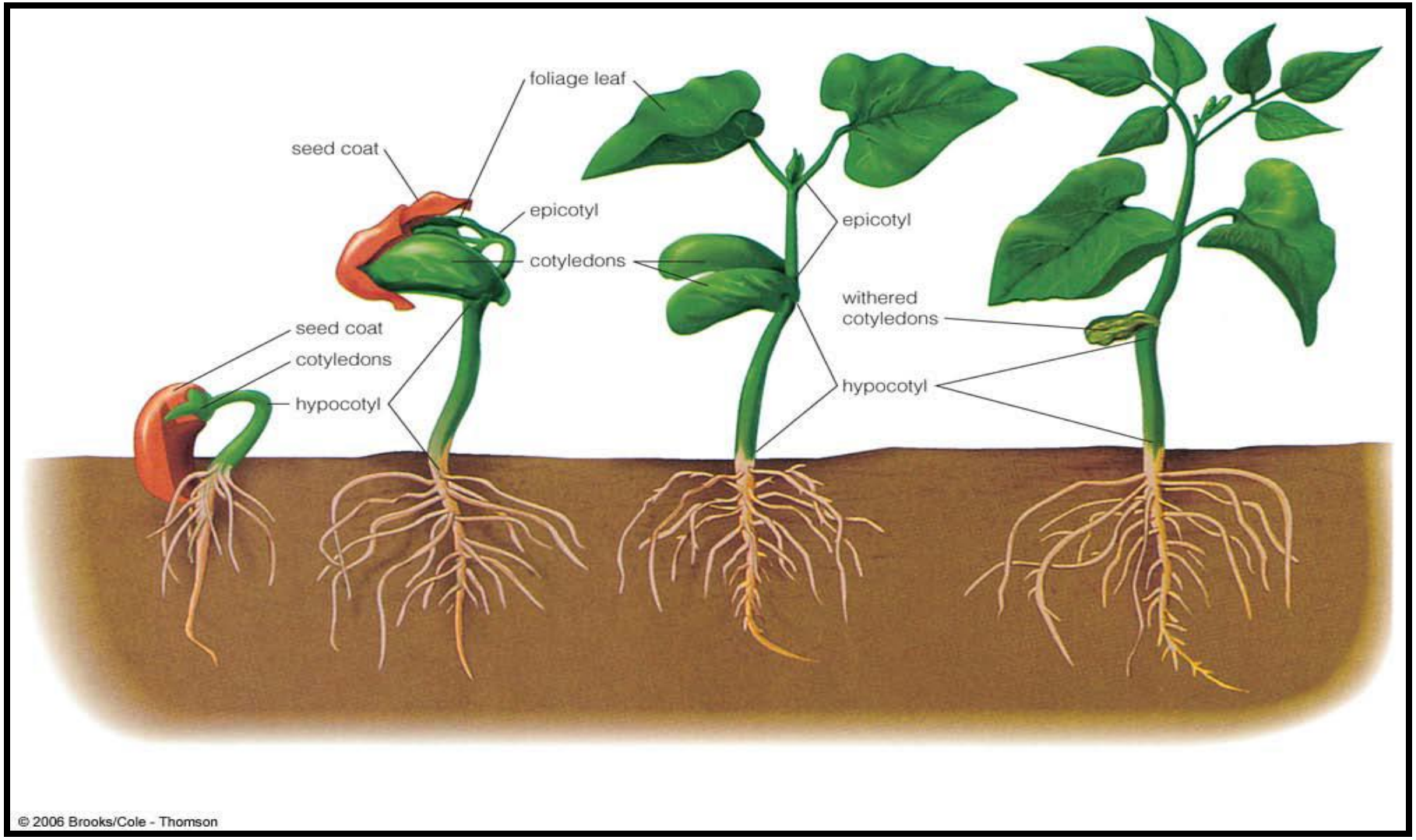
4. Viability: (vitality) and **longevity**. Viability is the germination capacity of the seeds, but longevity denotes the period the seed can remain dormant and viable.

Types of germination:

Germination is of three types: Epigeal or epigeous, hypogeal or hypogeous and viviparous.

1. Epigeal or epigeous germination: In this type, the hypocotyl grows first and it pushes the cotyledonary node and all other parts of the seed out of the soil.

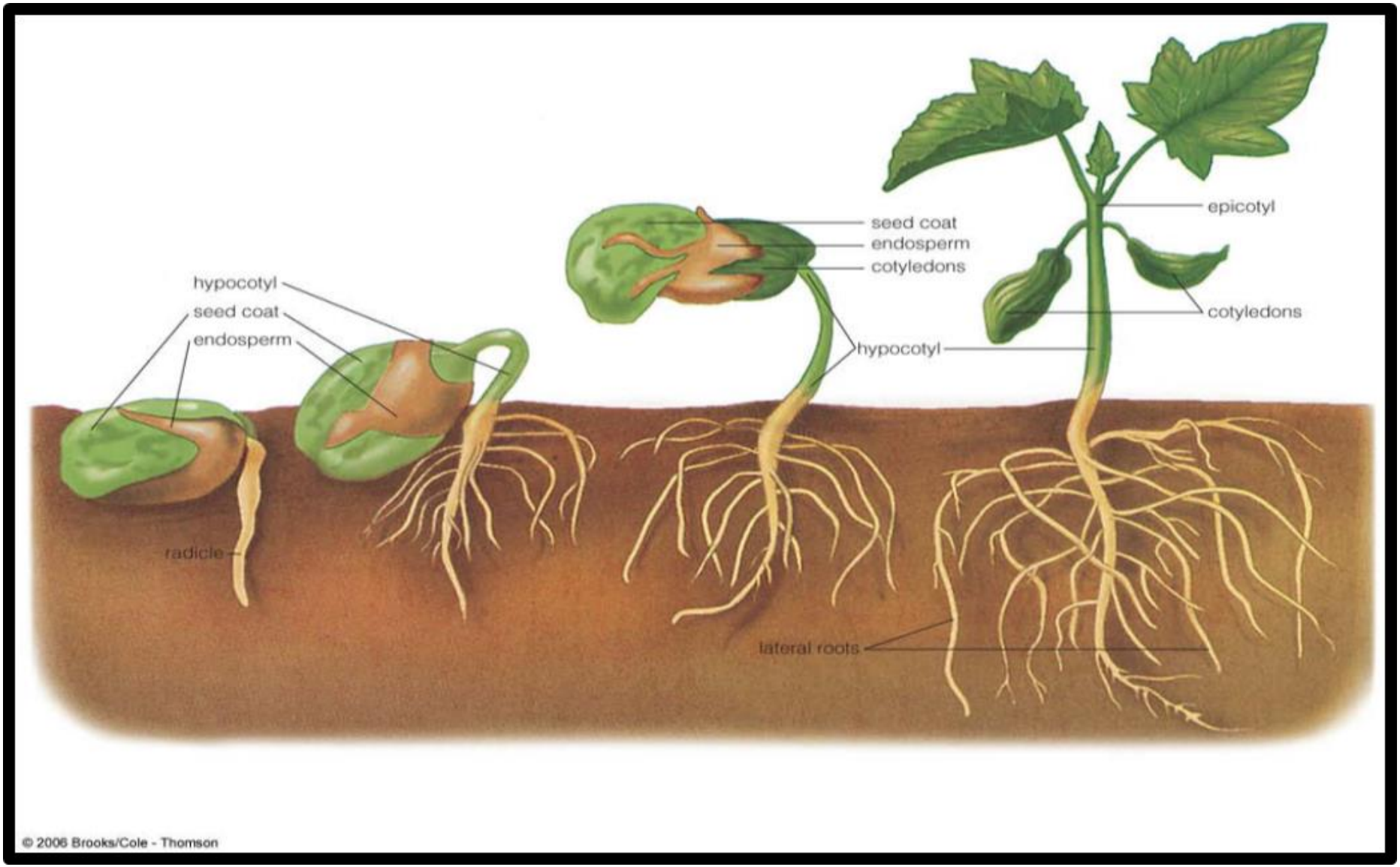
This type of germination is found in many dicotyledonous and a few monocotyledonous plants. Common examples are: Castor, bean, tamarind, etc.



Stages in the epigeal germination of a bean (*Phaseolus vulgaris*) seed.

2. Hypogeal or hypogeous germination: In this type, the epicotyl grows first and only the plumule is pushed out of the soil, while the cotyledons and all other parts remain at or below the soil surface.

This type of germination is noted in some dicotyledonous and many monocotyledonous plants. Common examples are: Maize, Wheat, Pea.



Stages in the hypogeal germination of a pea (*Pisum sativum*) seed

3. Viviparous germination: In this type, the seed, instead of being liberated from the fruit, germinates inside the fruit which is still attached with the mother plant. The embryo comes out of the fruit with the well-developed hypocotyl pointing downwards. Later on, it falls vertically downwards into the mud present around the mother plant by its own weight and fixes itself in the ground.

Vivipary is common in some mangrove plants like *Rhizophora mucronata*

Vivipary has also been reported in some mesophytes like squash (Sechium edule) of Cucurbitaceae.

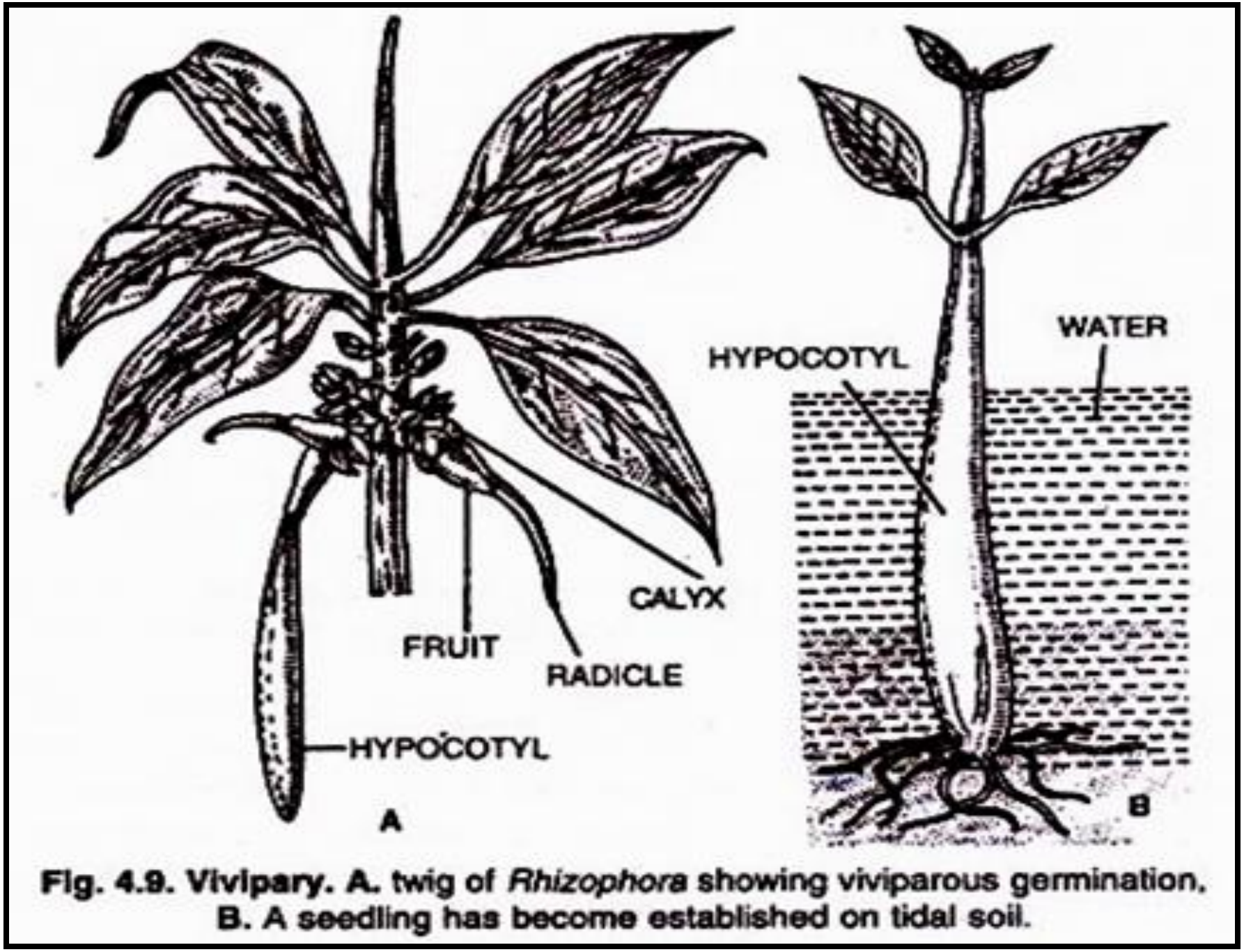


Fig. 4.9. Vivipary. A. twig of *Rhizophora* showing viviparous germination, **B.** A seedling has become established on tidal soil.

Mechanisms of seed germination:

1. Absorption of water by imbibition:

a. softening of seed coat.

b. Gas exchange

c. Release of energy due to imbibition

d. Formation of the pressure called pressure sowing which can break the rock.

2. Activation of bio-physiological process in embryo, when humidity of seed reach to 30- 40%.

3. Formation some plant hormones like Gibberellins (GA) in embryo.

4. Translocation of GA from embryo to aleuron layer.

5. GA stimulates some biological process:

a. Formation DNA

b. Formation RNA

c. Formation of protein

d. Increase activity of some enzymes like: amylase, lipase, maltase, and protease.

6. Translocation and diffusion these enzymes from aleuron to endosperm to digest and analysis of food storage in endosperm such as starch, etc.

7. Translocation of digested food from endosperm to active tissue, embryo like plumule and radicle.

8. Increase respiration rate and produce energy ATP which is necessary to build up phospholipids, cellulose, amino acids, and proteins to form new cellular substances.

9. Cell division in apices of radicle and plumule.

10. Elongation of cell and emergence of plumule and radicle.

11. Development of seedling capable (photosynthesis, absorption).