

OVERVIEW: As we have completed the survey of the Plant Kingdom, we have also studied

- 1) basic plant cell structure and how cells divide (SA #35) and
- 2) simple and complex tissue types (SA #41).

Your objective in this assignment should be to acquire an introductory knowledge of the development of the plant body from the embryo and subsequent *meristems*; and second, to understand the role of three primary meristems responsible for the development of *ground*, *dermal*, and *vascular tissue*.

PROCEDURE: We have already studied most of Chapter 4, but have not included pages 54-55 at the beginning. Please read these two pages. Use Chapter 5, pp 66-68 and Chapter 6, pages 88-90 for additional support. Then, read the STUDY OUTLINE which provides a logical flow of the concept of meristems and plant growth.

THEMES: Plant meristems are responsible for producing healthy, new cells which differentiate in an orderly manner to establish regions of dermal, ground, and vascular tissue in the growing plant body.

LECTURE DISCUSSION QUESTIONS:

1. What is the relationship between the primary meristems and the tissues such as dermal, vascular, and ground tissue during plant development?
2. Consult your study of the *Capsella* embryo from Laboratory Ex. #8, along with Figure 6.2, (Chapter 6) to explain the development of the plant stem axis following seed germination.
3. What is growth? How would you distinguish growth from development?

STUDY OUTLINE: MERISTEMS and PLANT GROWTH

I. INTRODUCTION -- How do plant cells organize into a multicellular plant body?

A. PLANTS ARE COMPOSED OF MANY DIFFERENT TISSUES

B. TISSUES, IN TURN, FORM THE ORGANIZATION OF ORGANS

1. THREE PLANT ORGANS – leaf, stem, root
2. Each organ has three tissue regions – dermal, vascular, ground tissue

II. VASCULAR PLANT DEVELOPMENT

A. Zygote ---> Mitosis + Cytokinesis + Differentiaton --> Embryo

B. SEED = embryo + food reserve [cotyledon or endosperm]

1. LEAF PRIMORDIA already in seed
2. MERISTEMS = region where undifferentiated cells divide

A. PLANT *versus* ANIMAL

1. Animal: Determinant growth -- short period of embryonic growth during which all body parts are formed – henceforth, increase in size only
2. Plant: Indeterminant growth -- meristems, continually embryonic cells, remain active throughout life – produce additional organs (*e.g.* leaves, flowers)

B. FUNCTIONS OF MERISTEMS

1. Primary meristems establish growth patterns for tissues and organs
2. Produce genetically healthy cells

IV. TYPES OF MERISTEMS

A. APICAL MERISTEMS -- two types: root apical and shoot apical (tip) meristem

B. LATERAL MERISTEMS -- produce secondary growth (girth)

C. INTERCALARY MERISTEMS -- growth between mature tissues (*e.g.* grasses)

D. PRIMARY MERISTEMS -- meristems *derived* from apical meristems

1. PROTODERM
 - a. Formed from *anticlinal division* of surface apical cells
 - b. In turn, develops into epidermis
2. PROCAMBIUM -- develops into vascular tissue
3. GROUND MERISTEM -- develops into core tissues (cortex and pith)

V. APICAL MERISTEMS – or “From where do new cells originate in a growing plant?”

A. SHOOT APICAL MERISTEM – *e.g. Coleus* (x-section) Figure 6.2, Ch. 6.

1. TUNICA -- outermost layer or two; divides anticlinally to --> protoderm
2. CORPUS -- inner layers; divide in all planes; consist of:
 - a. Peripheral Meristem – along with protoderm and procambium, produces leaf primordia
 - b. Pith-rib meristem -- produces vertical files of pith cells -> expand internodes]
 - c. Central Mother Cells -- supplies cells to peripheral and rib-meristems

B. ROOT APICAL MERISTEM

1. Divides to produce *root cap* as protection
2. Produces all root tissues toward shoot of plant
3. *Quiescent center* -- inner core of non-dividing cells; rebuilds damaged meristem

VI. LATERAL MERISTEMS – or “What keeps woody plants from “bursting their bark?”

- A. Vascular cambium -- produces secondary xylem and secondary phloem
- B. Phellogen -- produces *periderm* (outer bark; Chapter 6)

GROWTH = an irreversible increase in size of an organism resulting from

- A. Cell division -- more cells
- B. Cell enlargement -- cell wall loosening and stretching via turgor

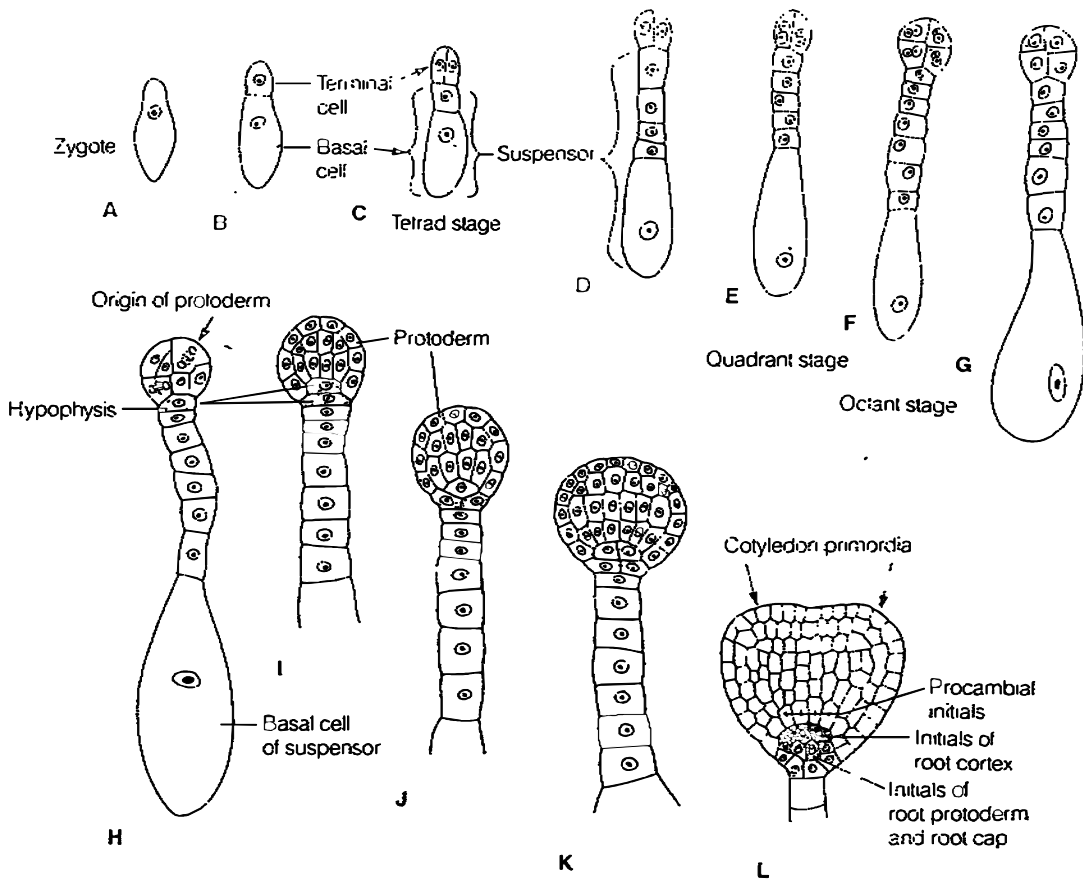


FIGURE 20-28 Early embryogeny in *Capsella bursa-pastoris*. A, B, division of zygote into terminal and basal cell; C, tetrad stage, the result of a longitudinal division in the terminal cell and a transverse division of the basal cell, resulting in the establishment of the suspensor; D-F, establishment of the octant stage; two of the nuclei in E and two nuclei in each tier in F are nuclei of cells in which the cell walls are in the plane of the page; G, octant stage as seen in sectional view; H, origin of protoderm and differentiation of hypophysis; I-L, results of division of the hypophysis in the establishment of root initials and the origin of the cotyledons. [Based on Souèges, *Ann. Sci. Nat. Bot. Ser.* 10:1-28, 1919.]

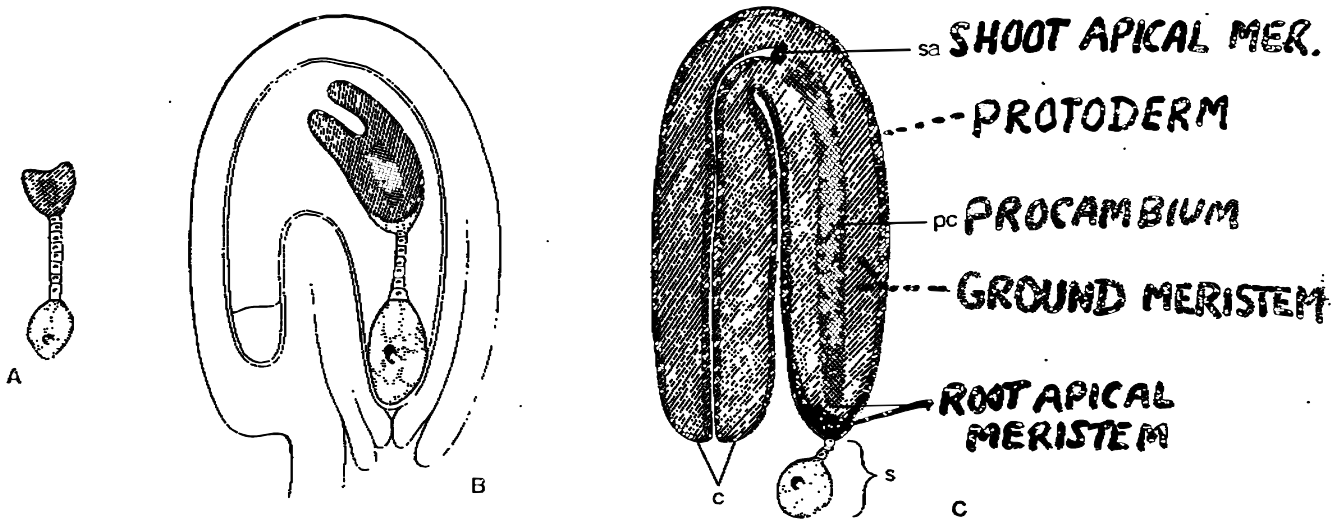


FIGURE 20-31 A, B, late stages in embryogeny of *Capsella*. A, the cordate form of a longisection of an embryo at stage of initiation of cotyledons; B, longisection of developing seed showing orientation and general structure of an embryo with two cotyledons; C, longisection of an embryo from a mature seed. c, cotyledons; pc, procambium; r, tip of root; s, suspensor; sa, shoot apex. [A and C redrawn from Schaffner, *Ohio Nat.* 7:1, 1906; B after Bergen and Caldwell and redrawn from *A Textbook of General Botany*, 4th edition, by R. M. Holman and W. W. Robbins. Wiley, New York, 1951.]