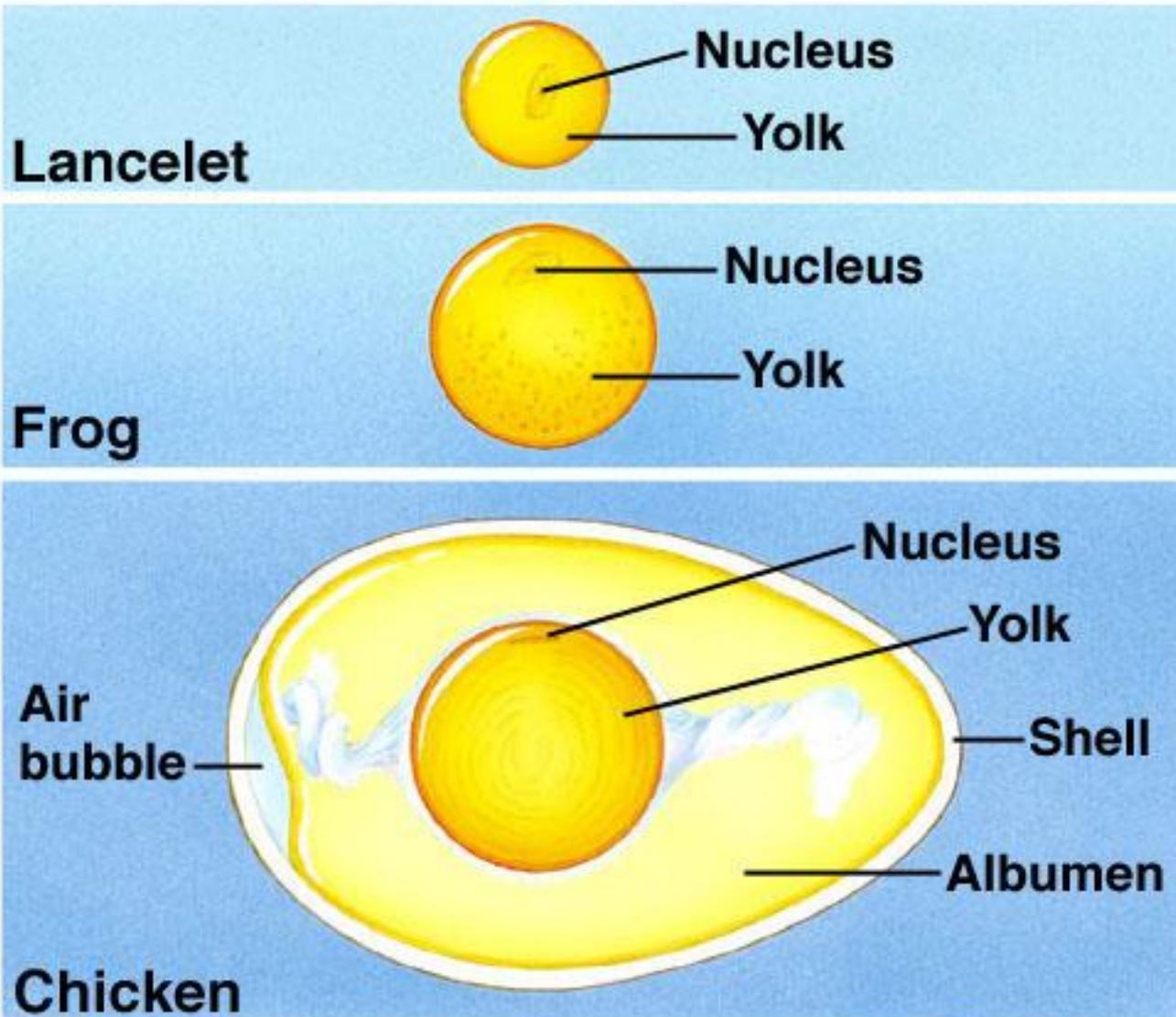


Stages of Vertebrate Development

Cleavage

- rapid cell division into a larger number of smaller cells
 - no overall increase in size of the embryo
- ball of cells = the **morula**
- pattern is dependent on the amount of yolk

Yolk Distribution



Holoblastic Cleavage



Figure 47.6 Cleavage in an echinoderm (sea urchin) embryo

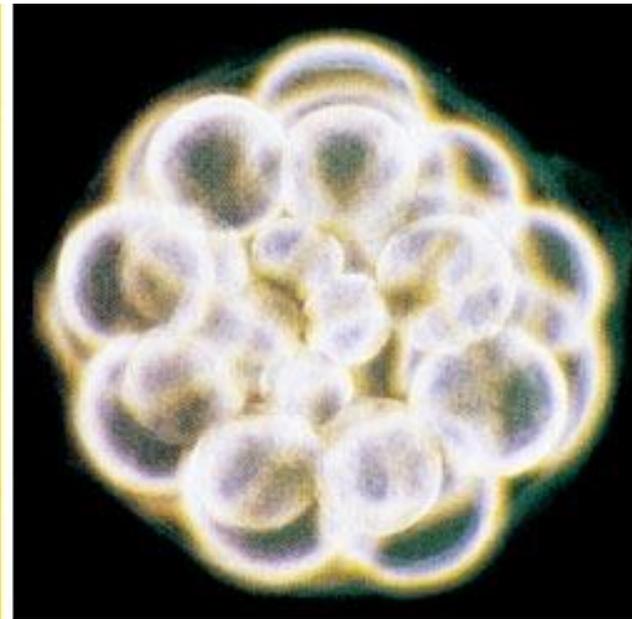
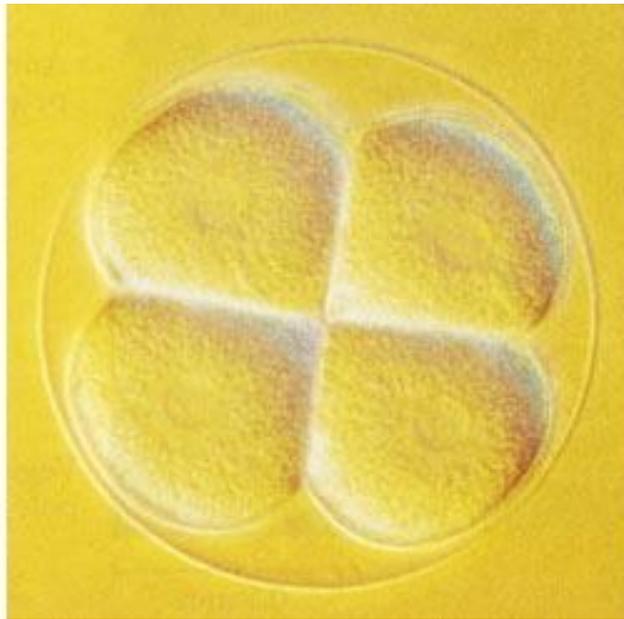
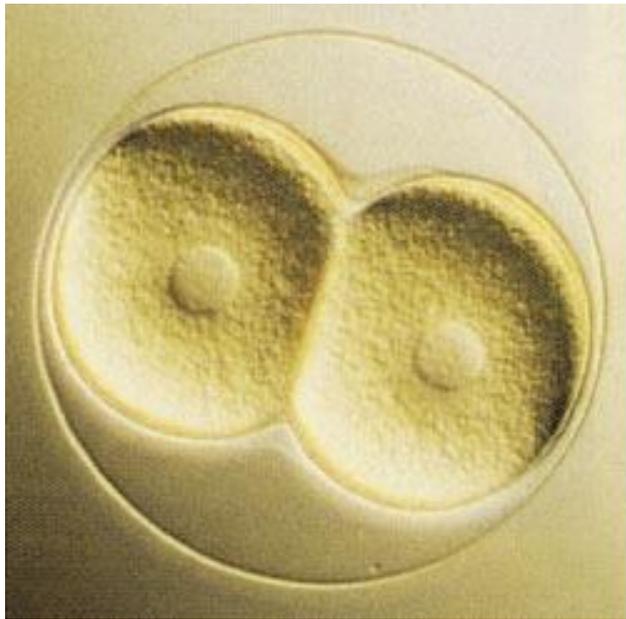
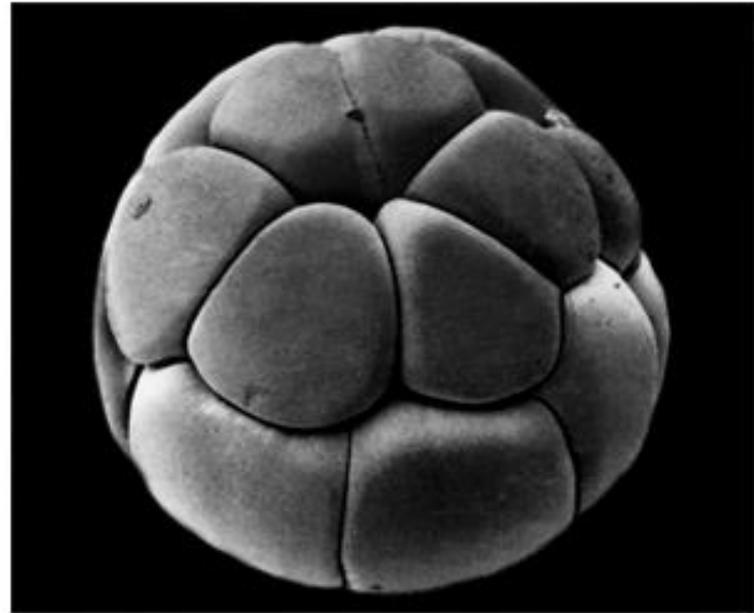
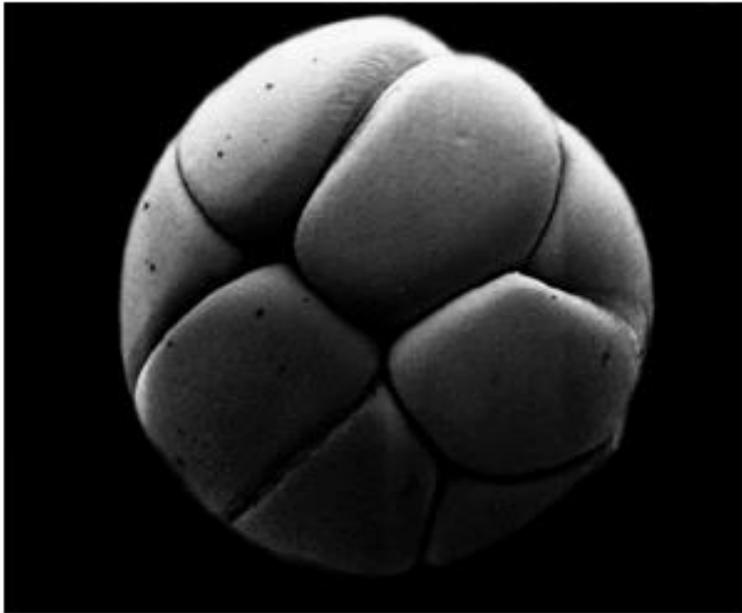
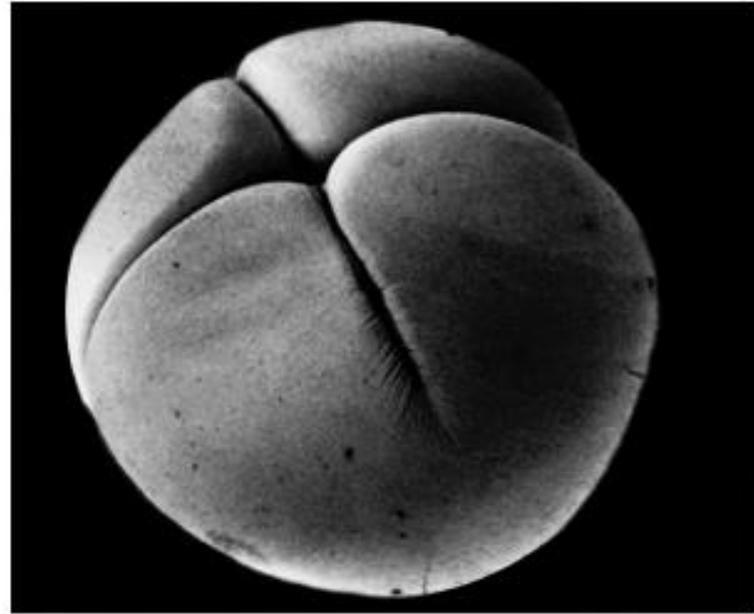
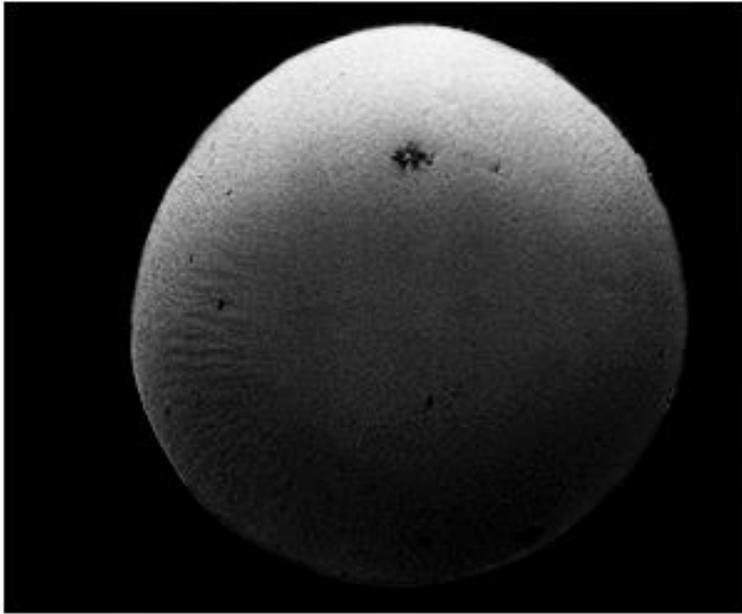
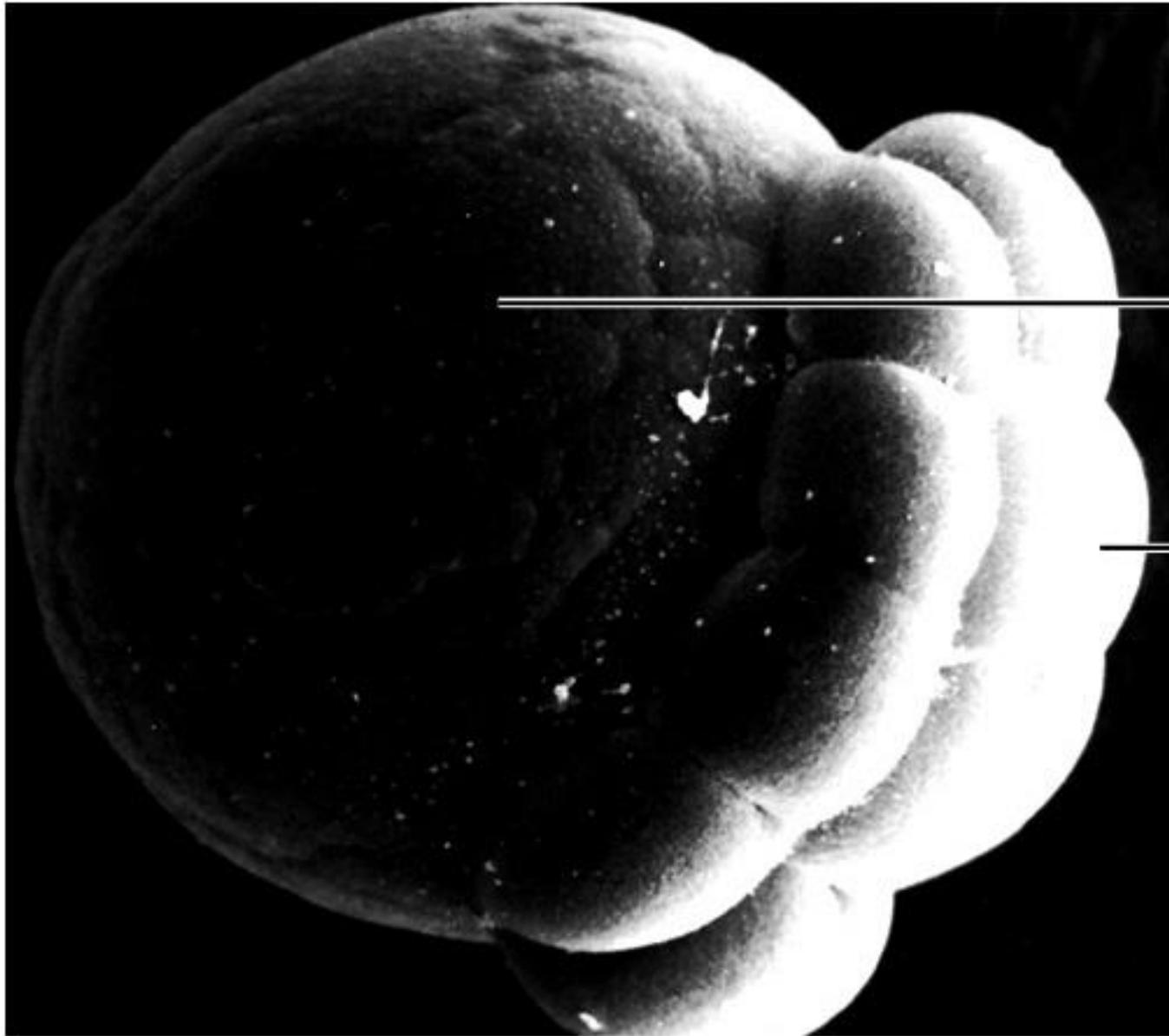


Figure 47.8x Cleavage in a frog embryo





Mero- blastic Cleavage

Yolk

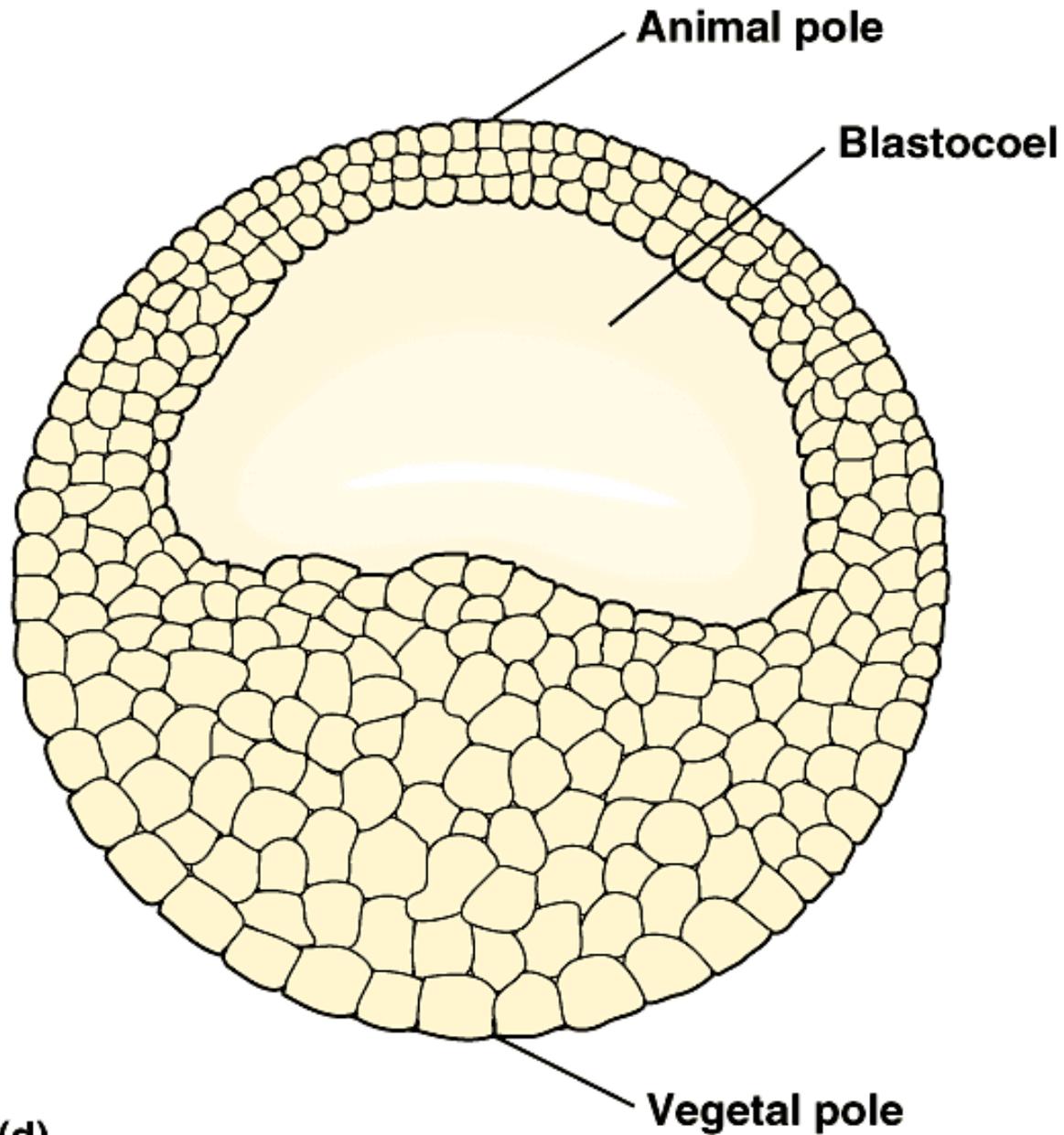
Cleaving
embryonic
cells

Stages of Vertebrate Development

Formation of Blastula

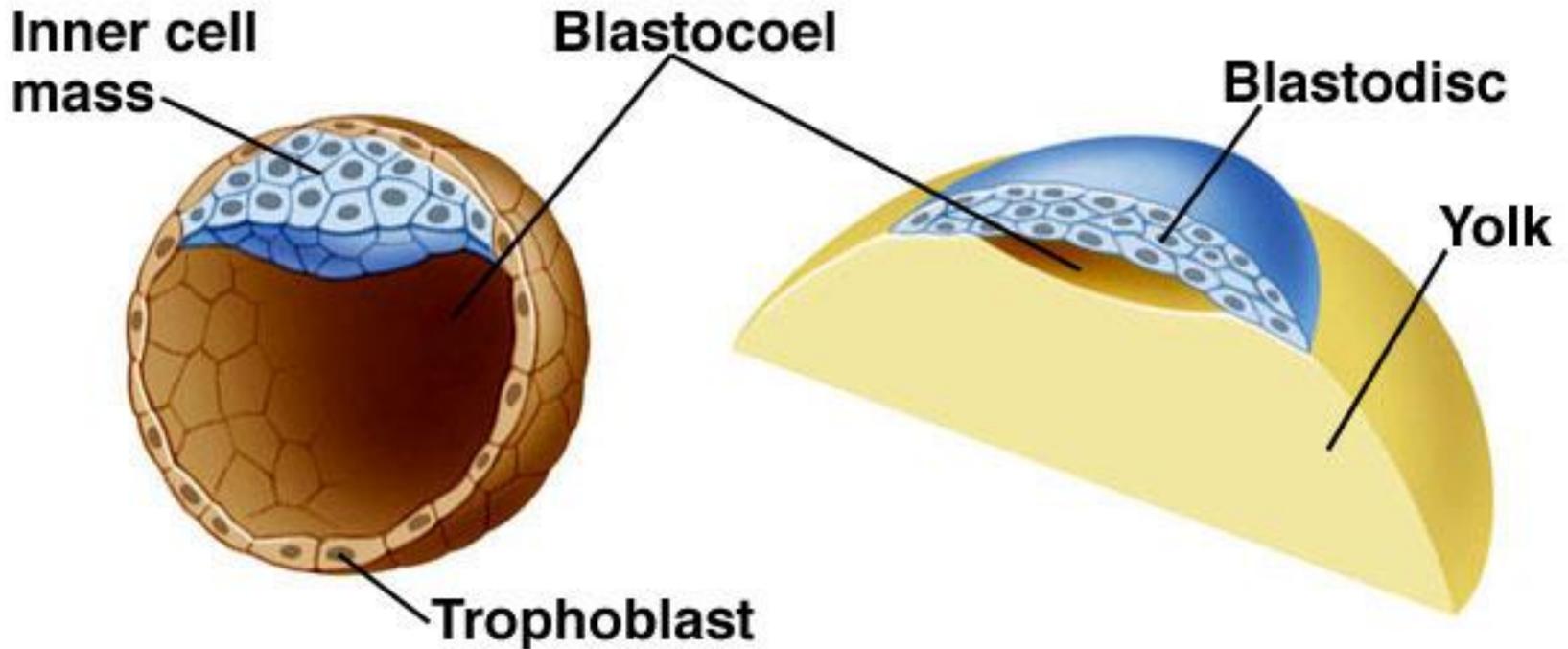
- A hollow ball of cells

Figure 47.8d Cross section of a frog blastula



(d)

Blastula of Mammals and Birds



Mammalian Blastula

Bird Blastula

Stages of Vertebrate Development

Gastrulation

- One wall of blastula pushes inward
- First opening to central gut = blastopore
- Three germ layers form
 - endoderm (become internal organs)
 - mesoderm (form bones, blood vessels, muscles, connective tissue)
 - ectoderm (skin and nervous system)
- Pattern dependent on yolk distribution

Figure 47.9 Sea urchin gastrulation (Layer 1)

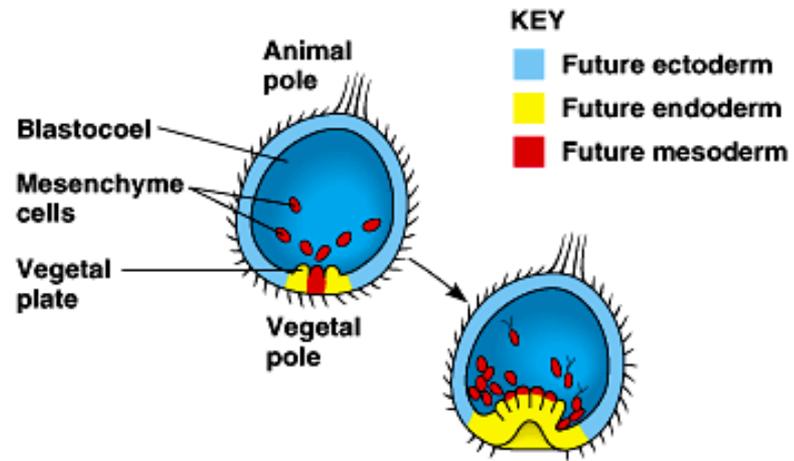


Figure 47.9 Sea urchin gastrulation (Layer 2)

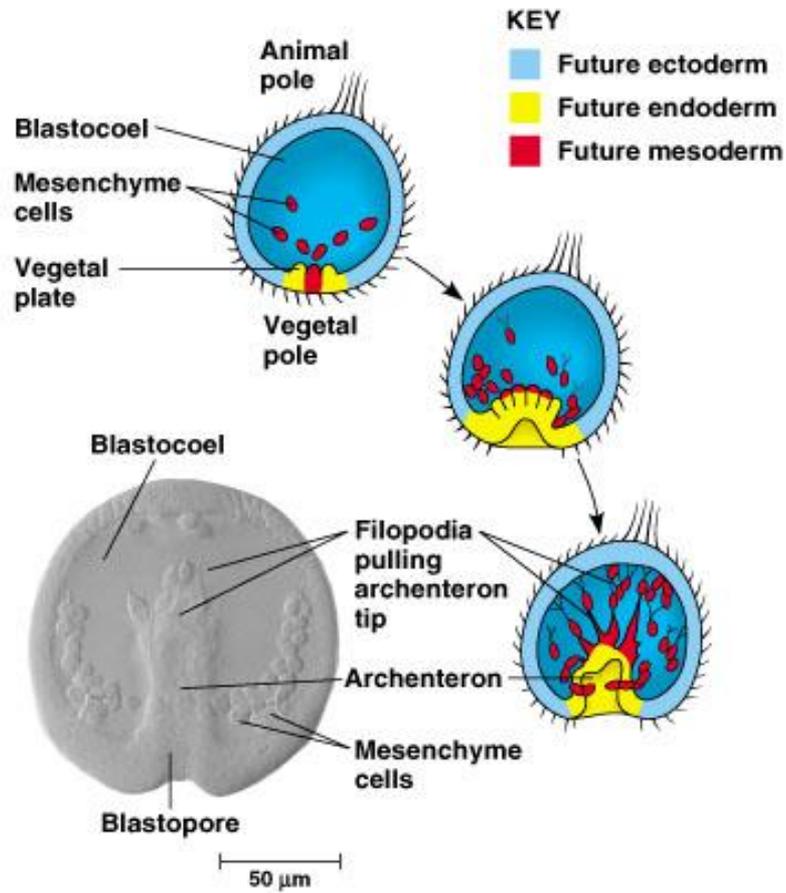


Figure 47.9 Sea urchin gastrulation (Layer 3)

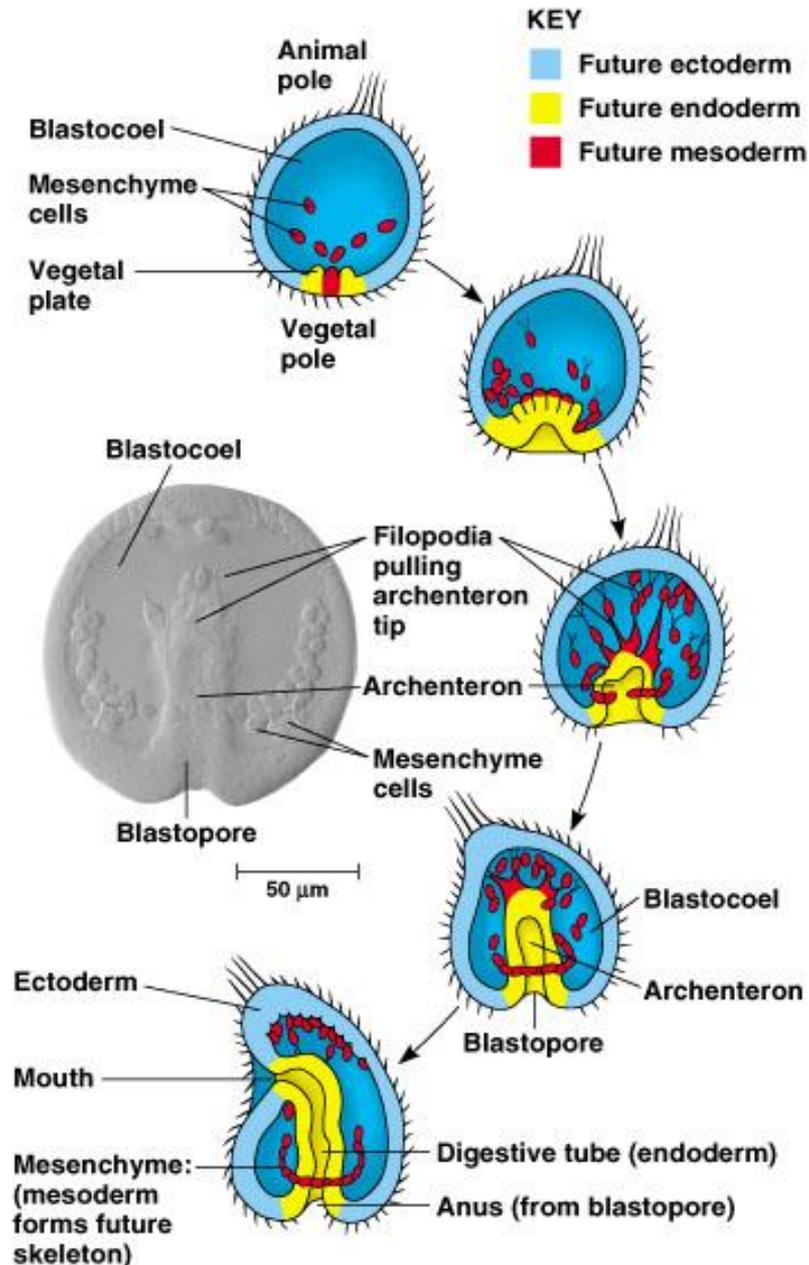


Figure 47.10 Gastrulation in a frog embryo

KEY

- Future ectoderm
- Future endoderm
- Future mesoderm

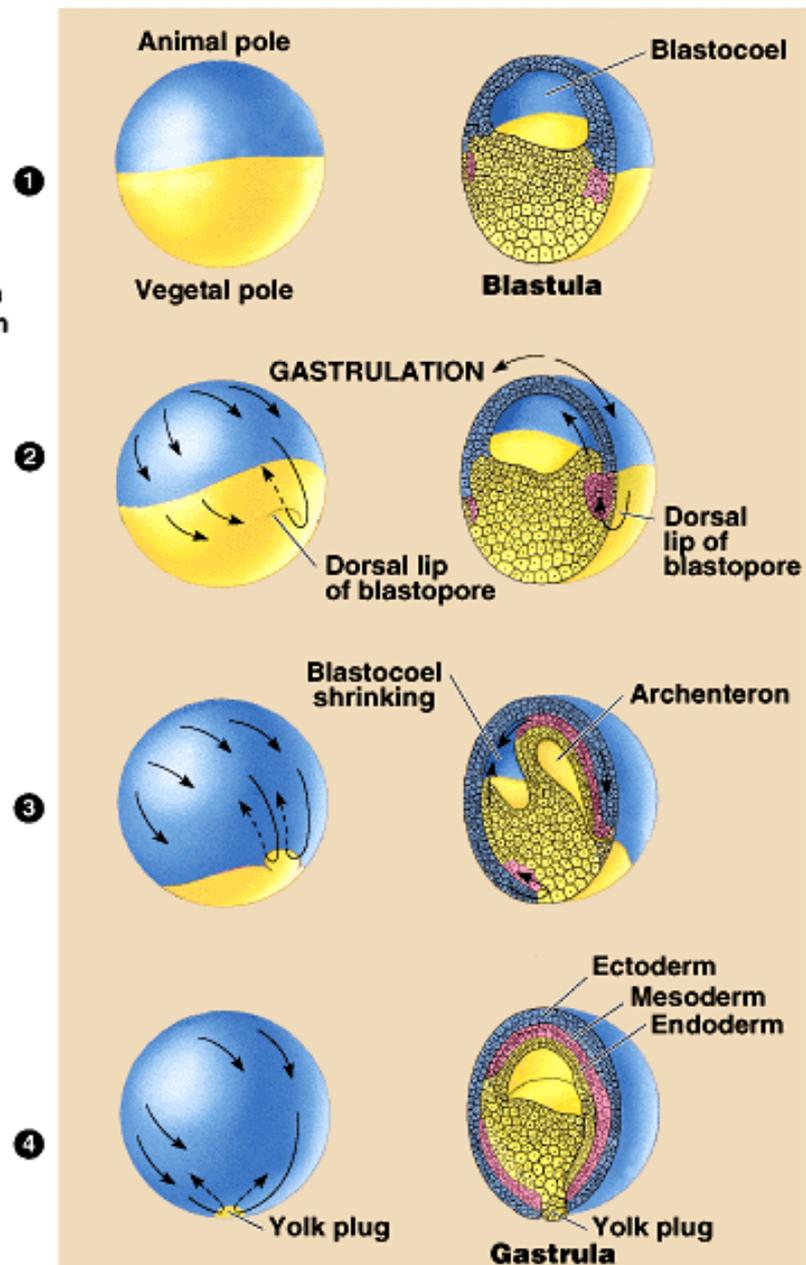
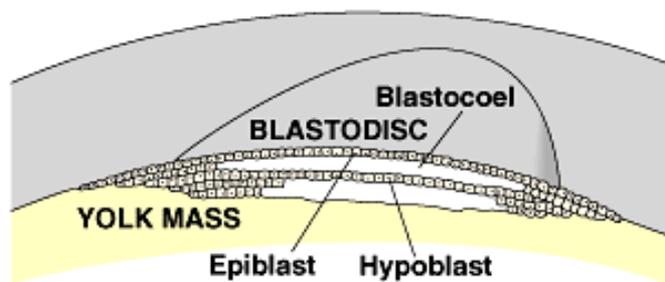
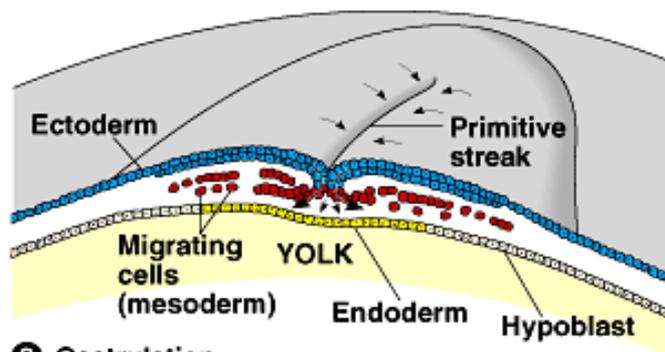


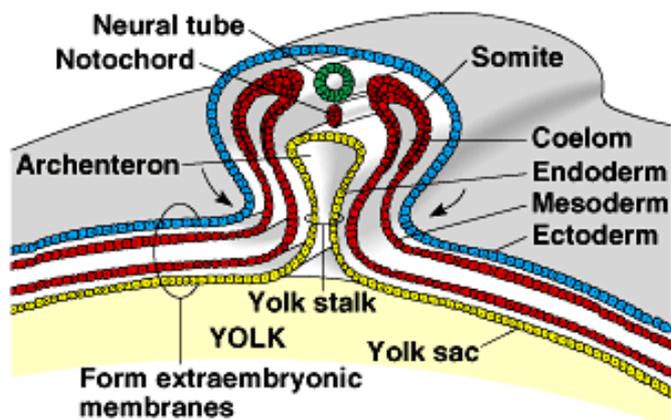
Figure 47.12 Cleavage, gastrulation, and early organogenesis in a chick embryo



1 Cleavage

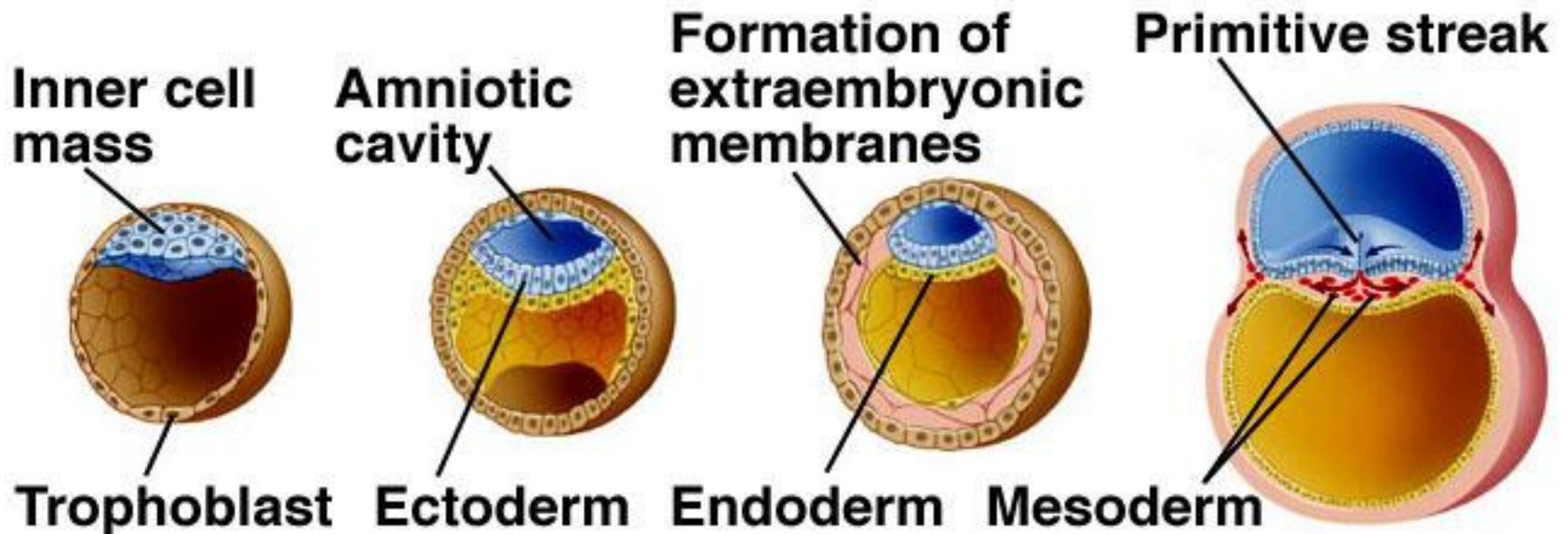


2 Gastrulation



3 Early organogenesis

Gastrulation – Mammal



Extraembryonic Membranes — Mammalian Embryo (1)

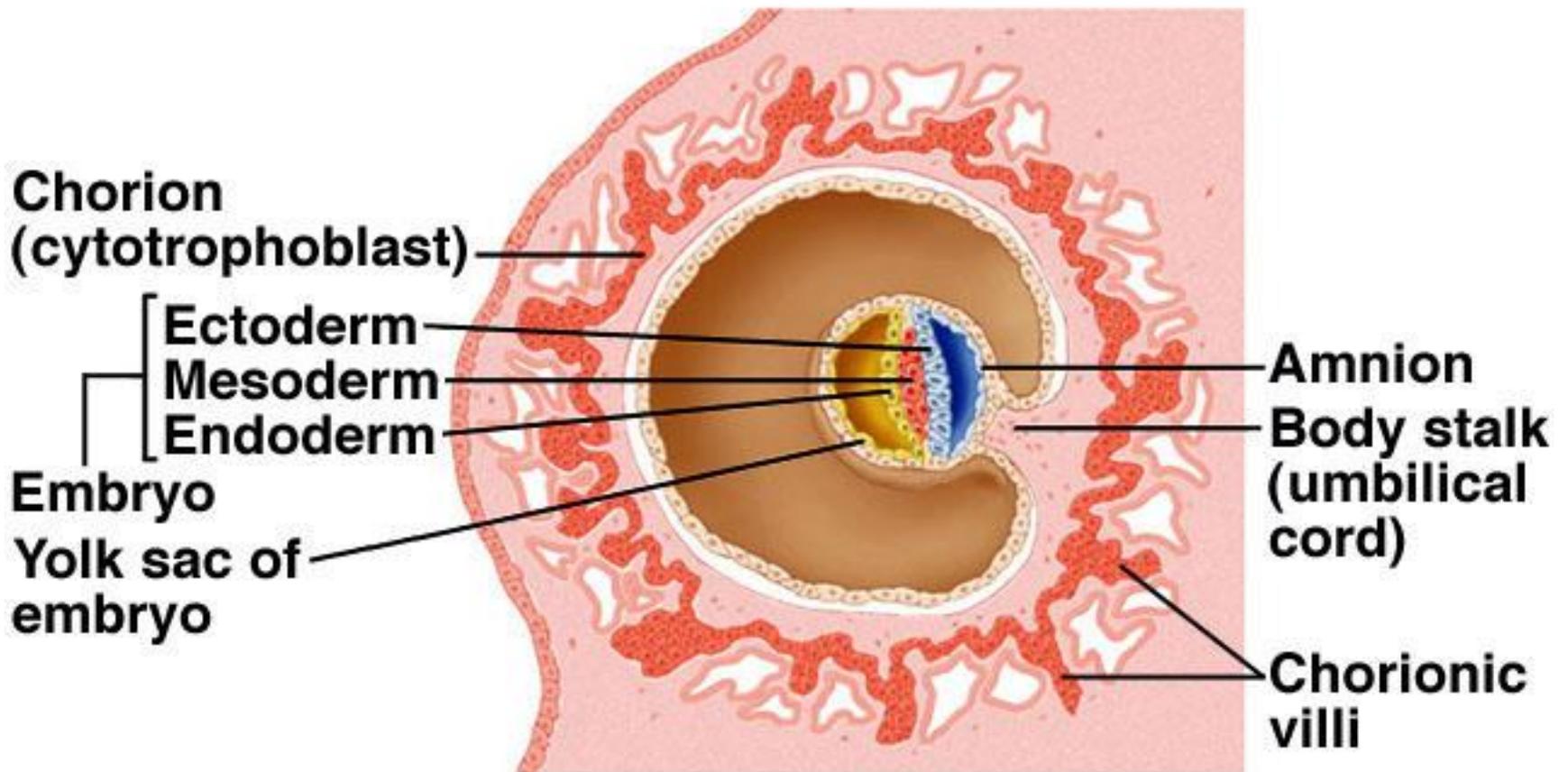
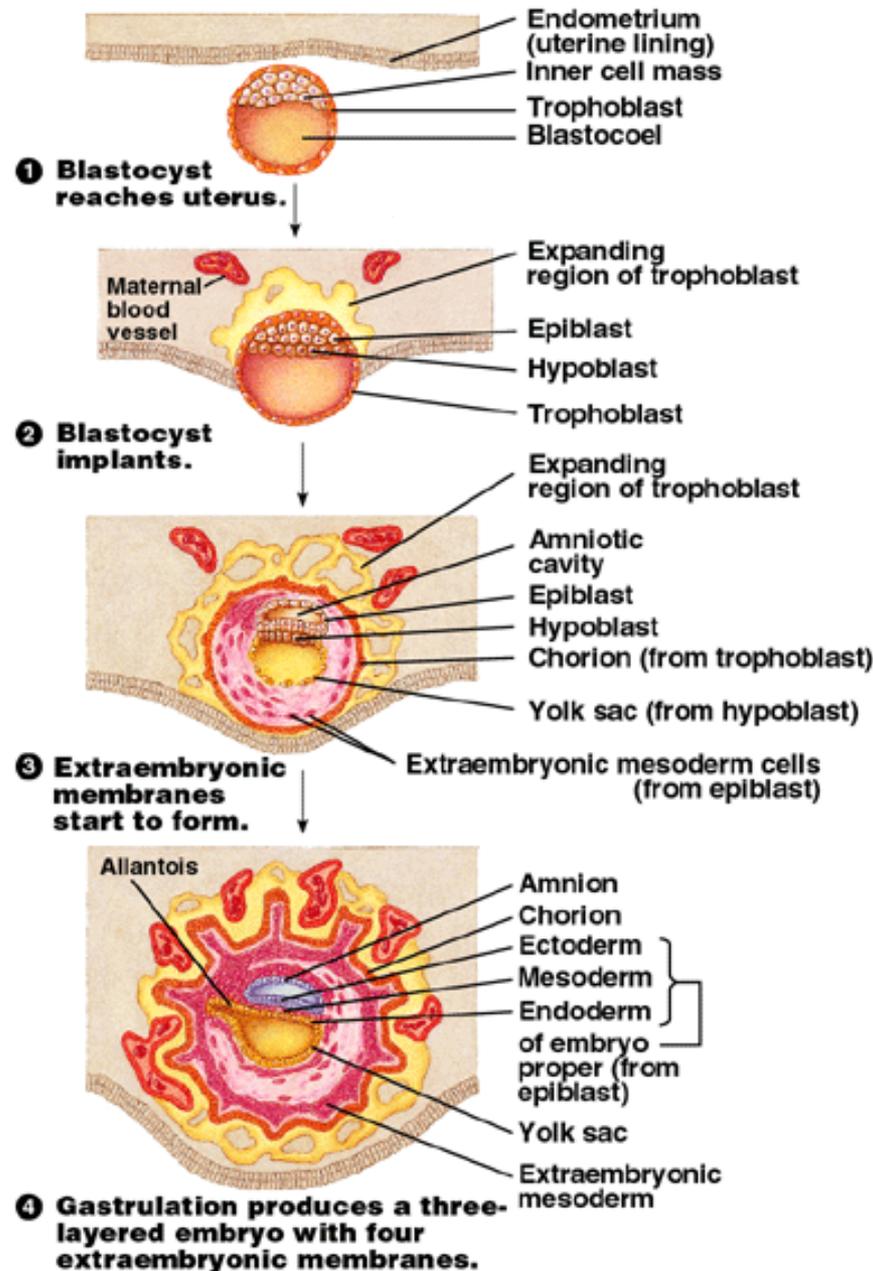


Figure 47.15 Early development of a human embryo and its extraembryonic

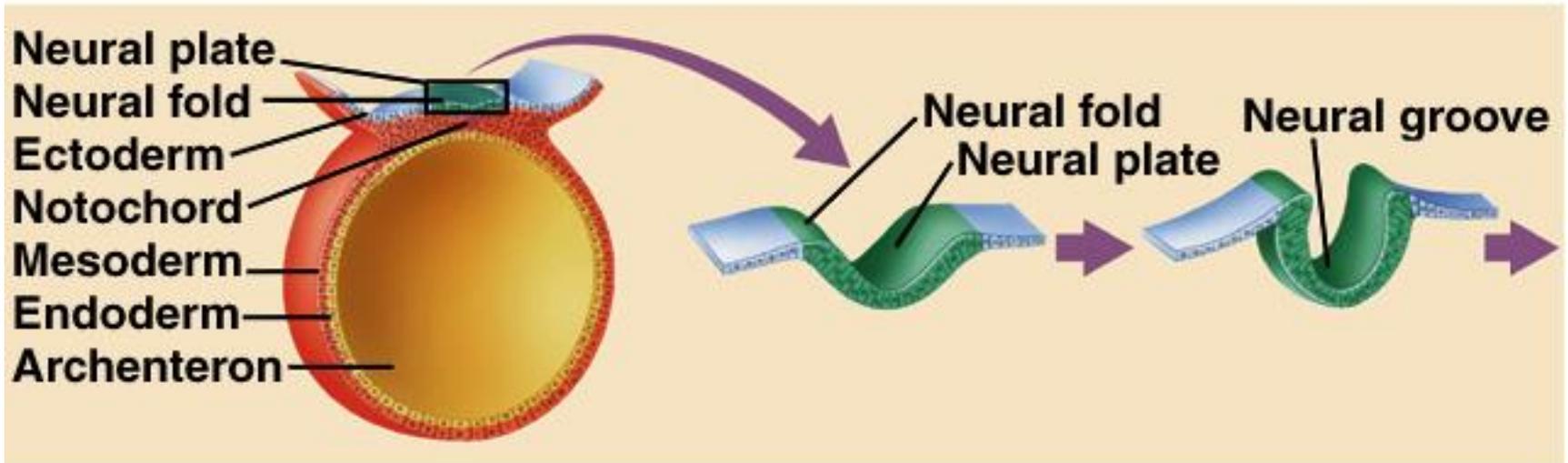


Stages of Vertebrate Development

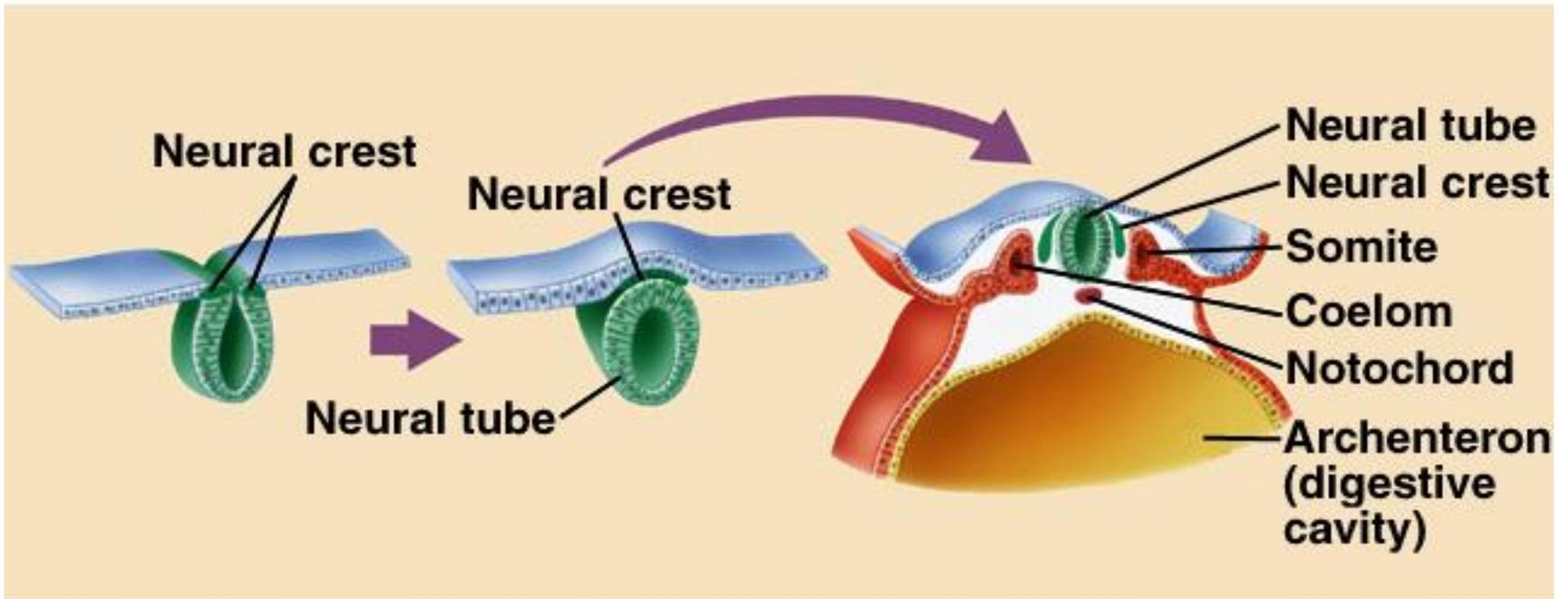
Neurulation

- the cells above the notochord roll into a tube that pinches off
 - = the neural tube (becomes the spinal cord)

Neural Tube Formation (1)



Neural Tube Formation (2)



Stages of Vertebrate Development

Cell Migration

- Cells migrate to different parts of the embryo to form distant tissues
 - Ex: cells of neural crest form sense organs
- the basic vertebrate body plan is formed

Stages of Vertebrate Development

Organogenesis

- Tissues develop into organs

Table 47.1 Derivatives of the Three Embryonic Germ Layers in Vertebrates

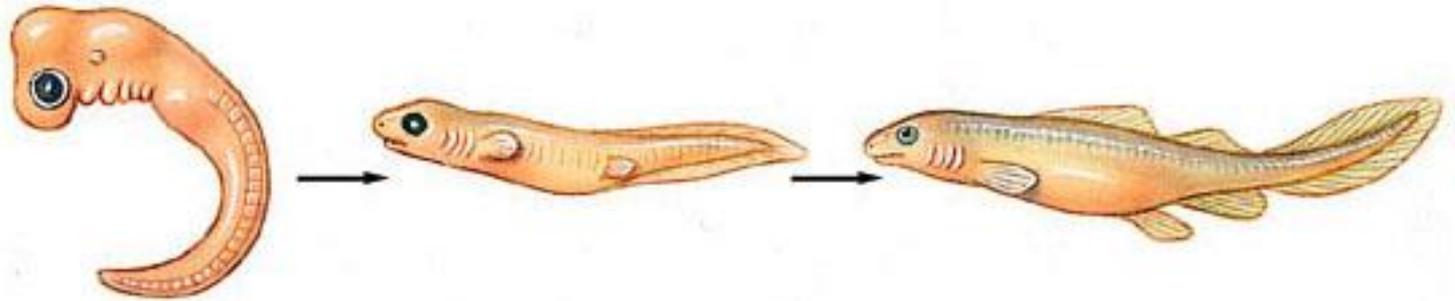
Germ Layer	Organs and Tissues in the Adult
Ectoderm	Epidermis of skin and its derivatives (e.g., skin glands, nails); epithelial lining of mouth and rectum; sense receptors in epidermis; cornea and lens of eye; nervous system; adrenal medulla; tooth enamel; epithelium of pineal and pituitary glands.
Endoderm	Epithelial lining of digestive tract (except mouth and rectum); epithelial lining of respiratory system; liver; pancreas; thyroid; parathyroids; thymus; lining of urethra, urinary bladder, and reproductive system.
Mesoderm	Notochord; skeletal system; muscular system; circulatory and lymphatic systems; excretory system; reproductive system (except germ cells, which start to differentiate during cleavage); dermis of skin; lining of body cavity; adrenal cortex.

Biogenetic Law

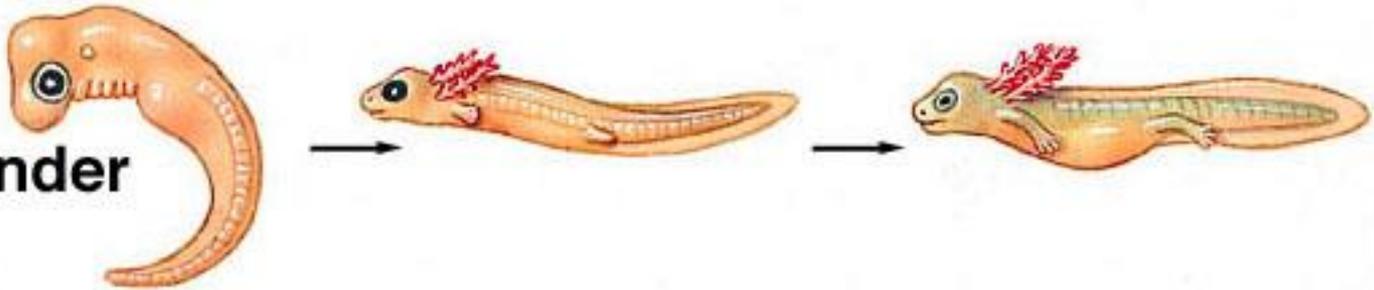
- Ernst Haeckel
- Ontogeny recapitulates phylogeny
- Developmental patterns of more recently evolved groups are built on more primitive patterns

Embryonic Development of Vertebrates (1)

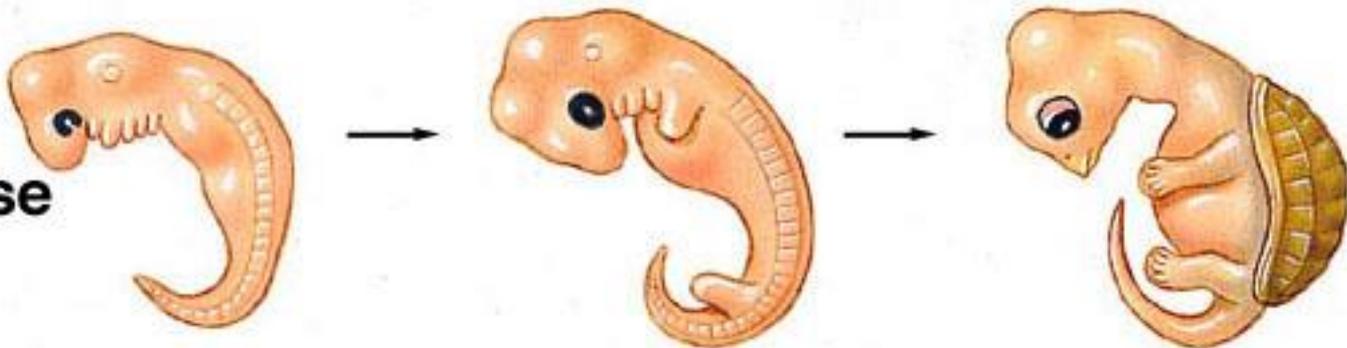
Fish



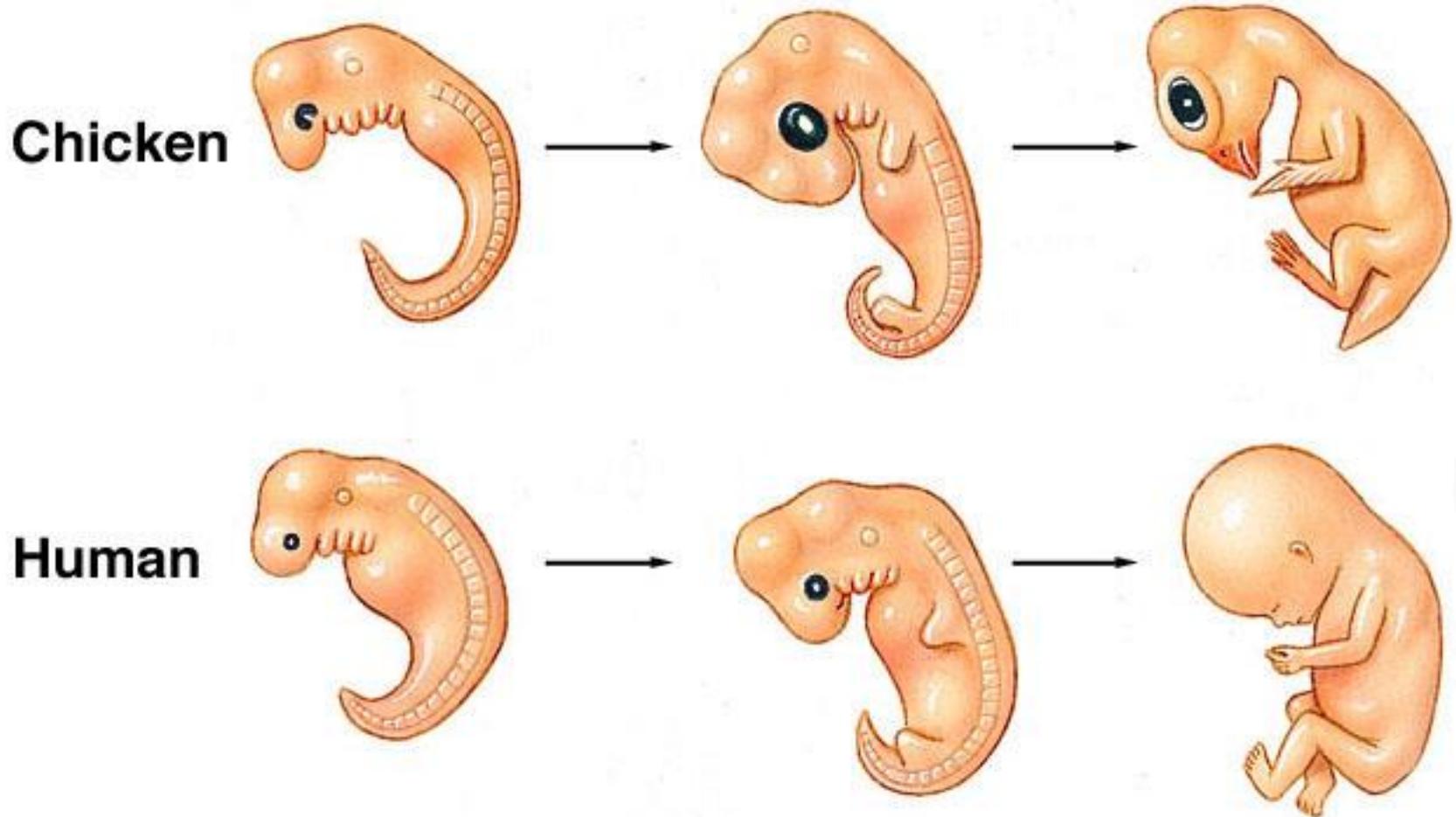
Salamander



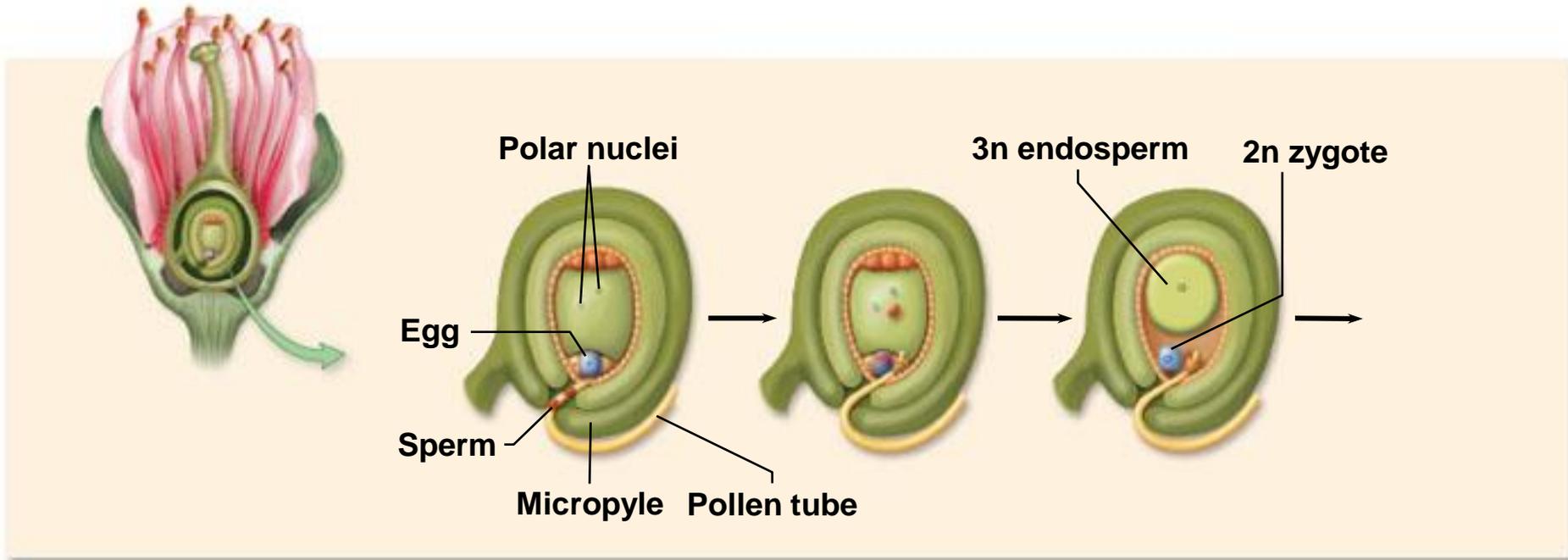
Tortoise



Embryonic Development of Vertebrates (2)



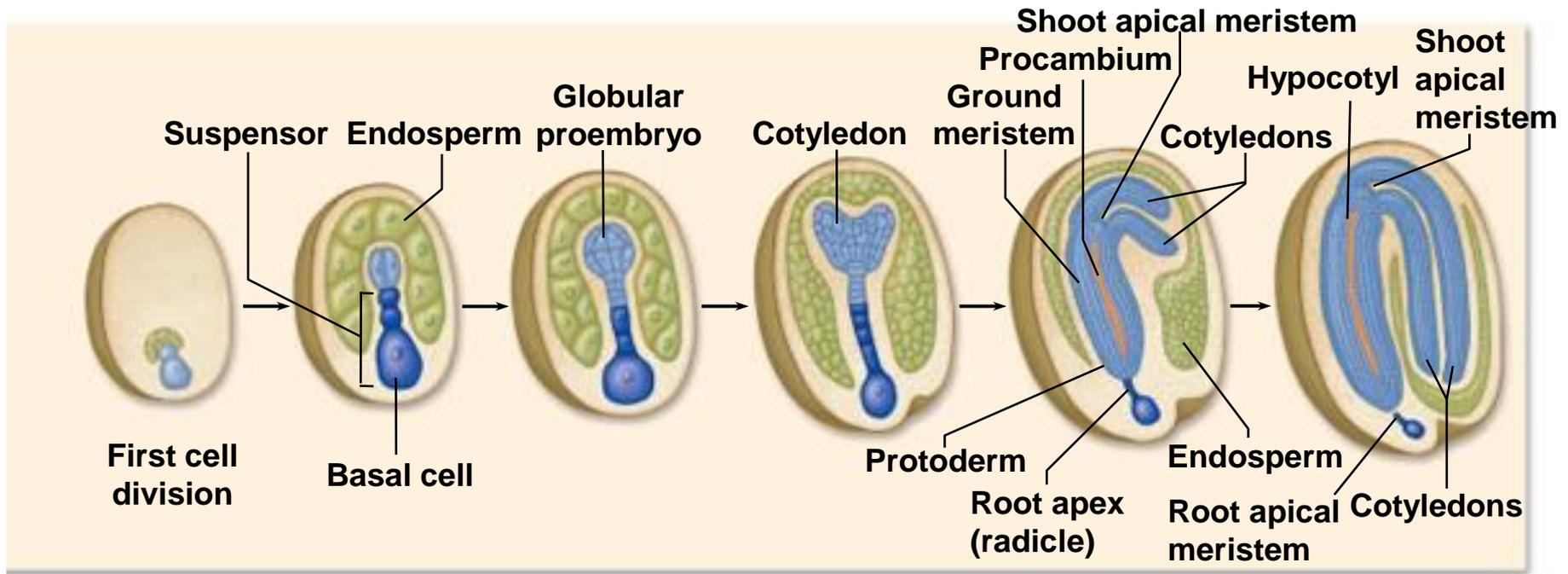
Angiosperm Embryo Development



Stages of Plant Development

- **Asymmetric Early Cell Division**
 - Embryo
 - Suspensor – transfers food to embryo
 - Cells near suspensor become root

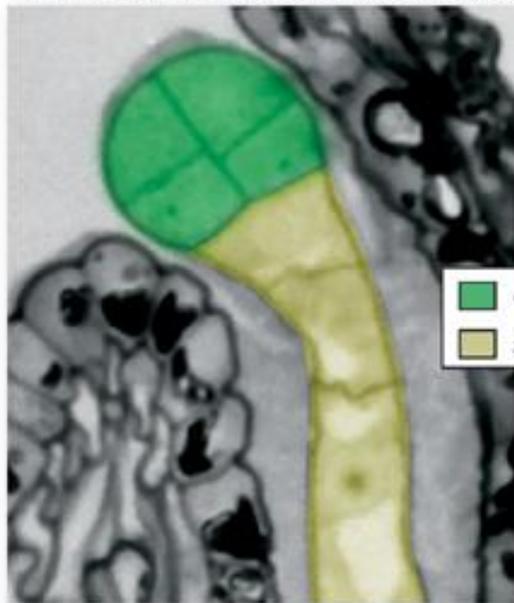
Angiosperm Embryo Development



Stages of Plant Development

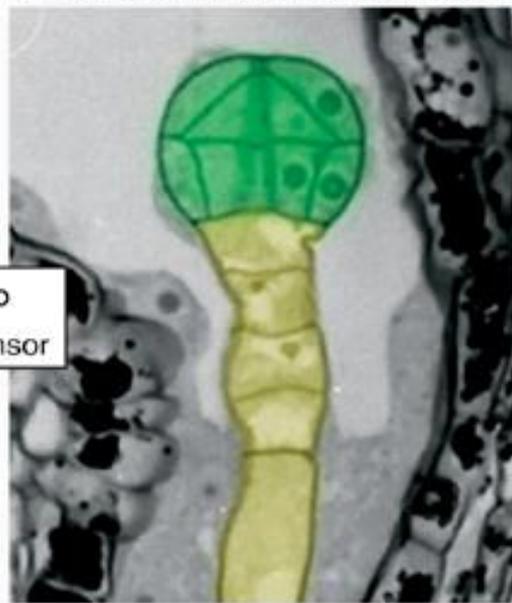
- **Tissue formation**

- Protoderm...Epidermal – external surface of plant
- Ground Meristem...Ground tissue –food & water storage
- Procambium...Vascular tissue –xylem & phloem

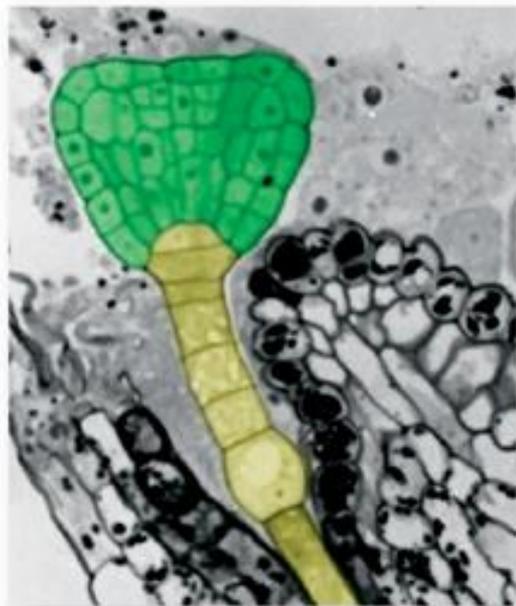


embryo
suspensor

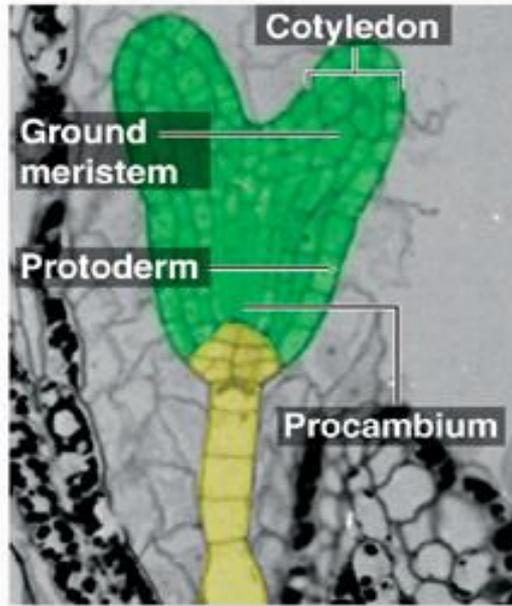
a.



b.



c.



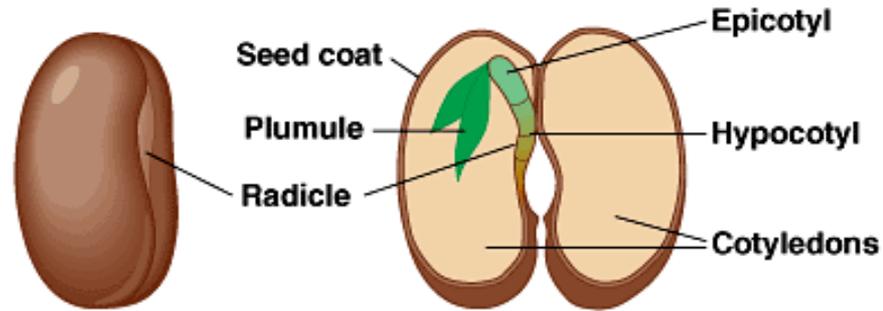
d.

Stages of Plant Development

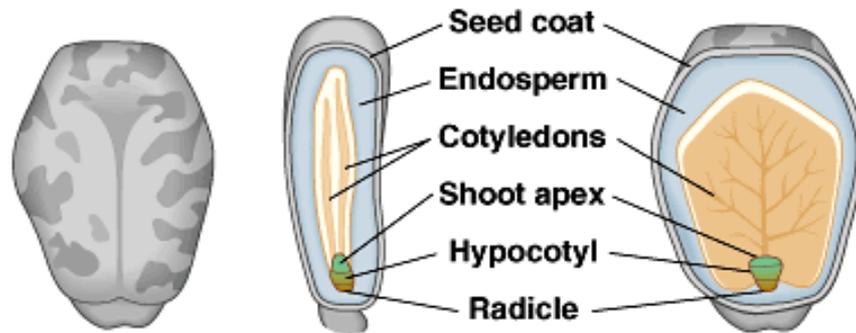
- **Seed formation**

- One or two seed leaves (cotyledons) form
 - May absorb food from endosperm
- Seed coat forms
- May exist in dormant state (hundreds of years)
- resistant to harsh conditions

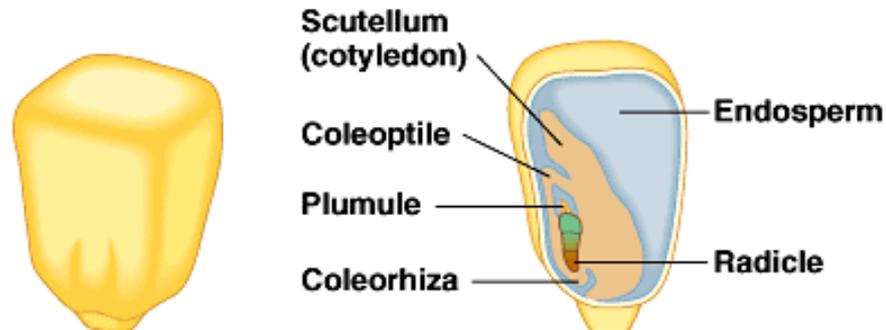
Figure 38.11 Seed structure



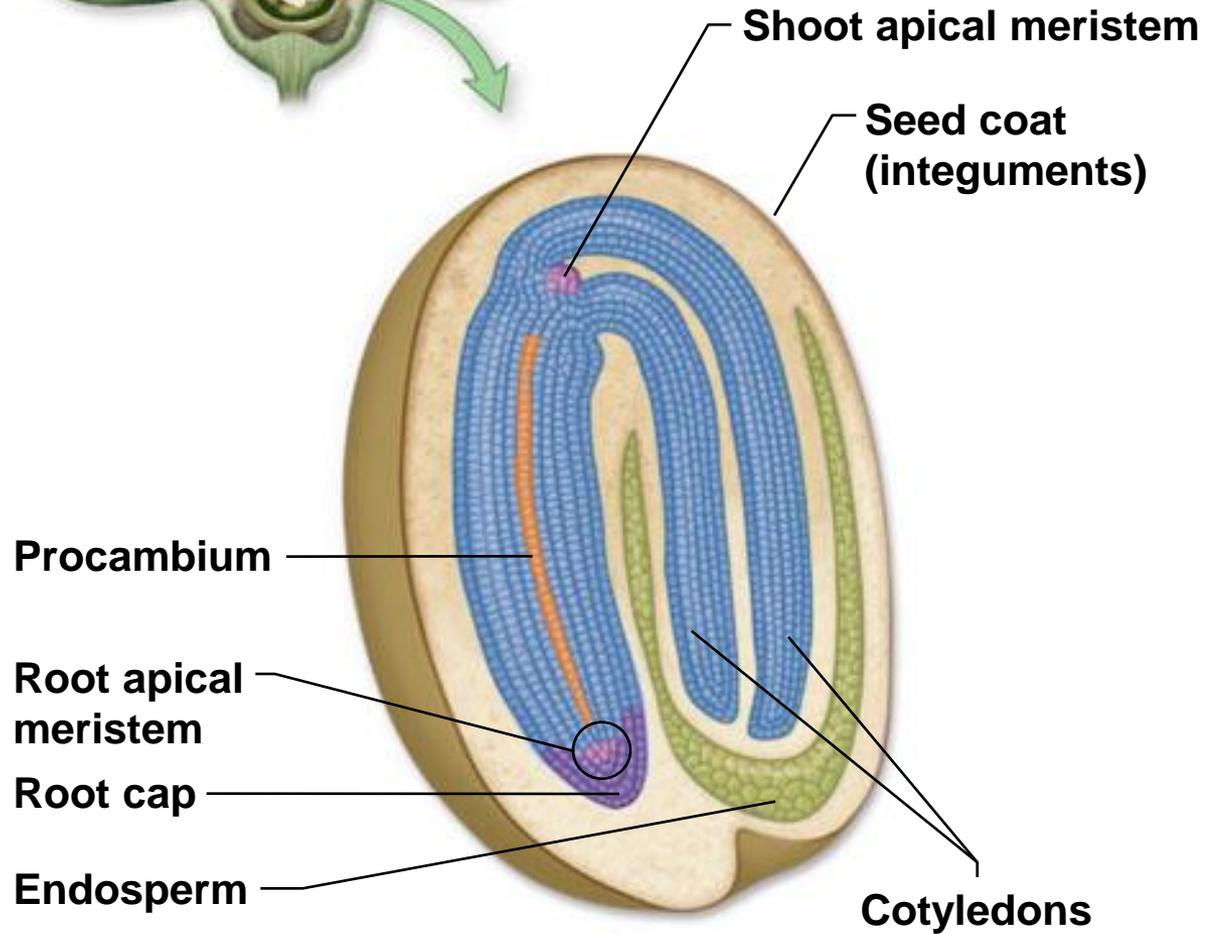
(a) Common bean

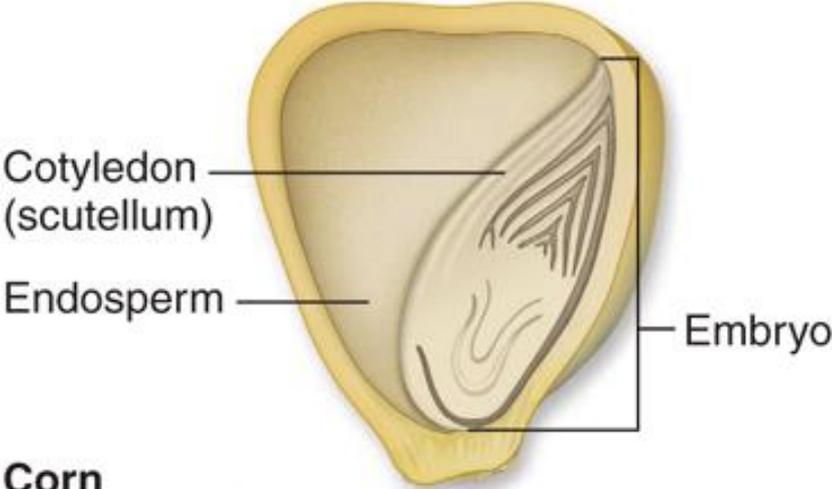


(b) Castor bean

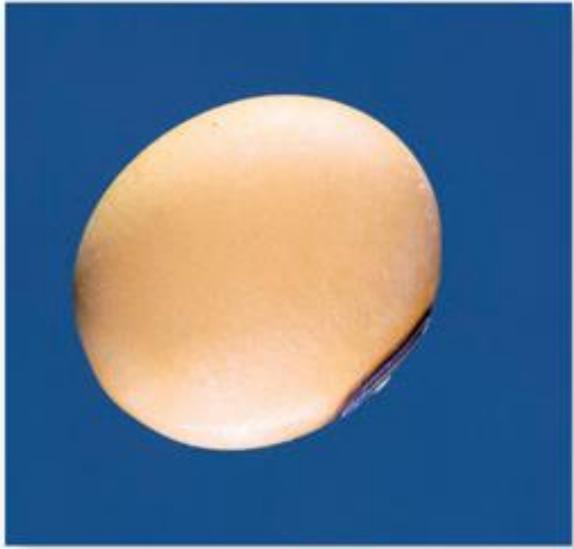
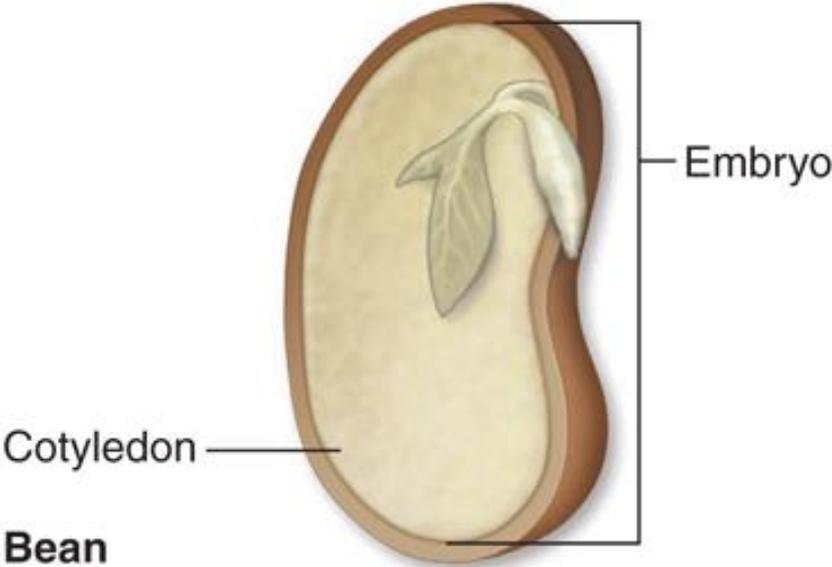


(c) Corn





Corn



Bean

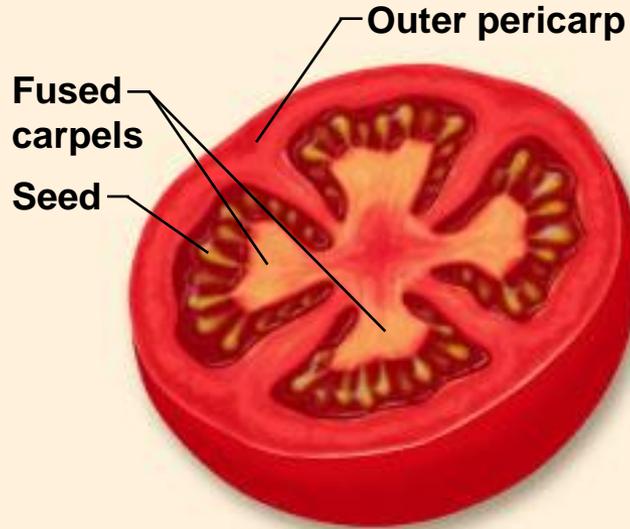
Fruits

Fruits are most simply defined as mature ovaries (carpels)

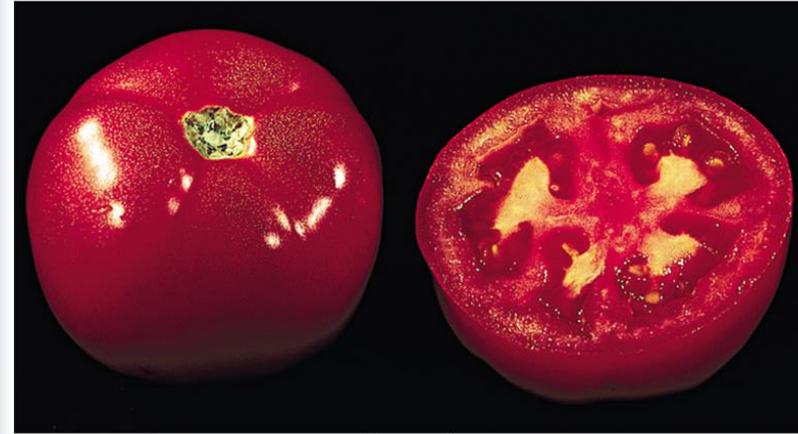
-During seed formation, the flower ovary begins to develop into fruit

True Berries

The entire pericarp is fleshy, although there may be a thin skin. Berries have multiple seeds in either one or more ovaries. The tomato flower had four carpels that fused. Each carpel contains multiple ovules that develop into seeds.



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Legumes

Split along two carpel edges (sutures) with seeds attached to edges; peas, beans. Unlike fleshy fruits, the three tissue layers of the ovary do not thicken extensively. The entire pericarp is dry at maturity.



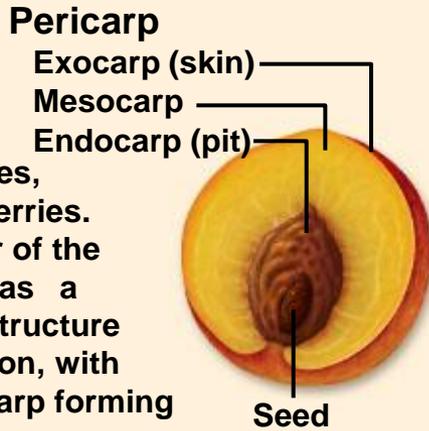
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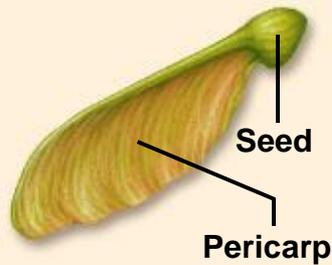
Drupes

Single seed enclosed in a hard pit; peaches, plums, cherries. Each layer of the pericarp has a different structure and function, with the endocarp forming the pit.



Samaras

Not split and with a wing formed from the outer tissues; maples, elms, ashes.



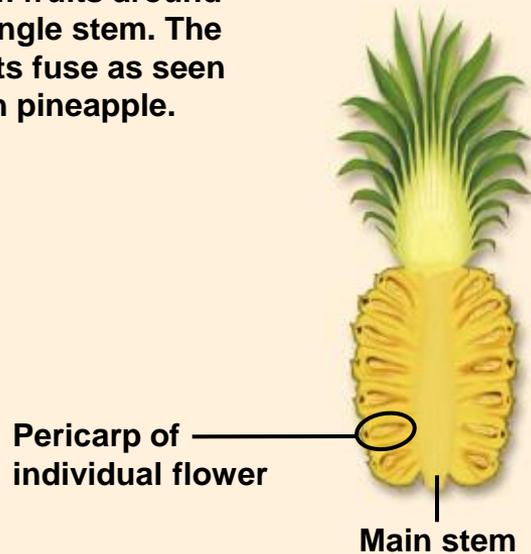
Aggregate Fruits

Derived from many ovaries of a single flower; strawberries, blackberries. Unlike tomato, these ovaries are not fused and covered by a continuous pericarp.



Multiple Fruits

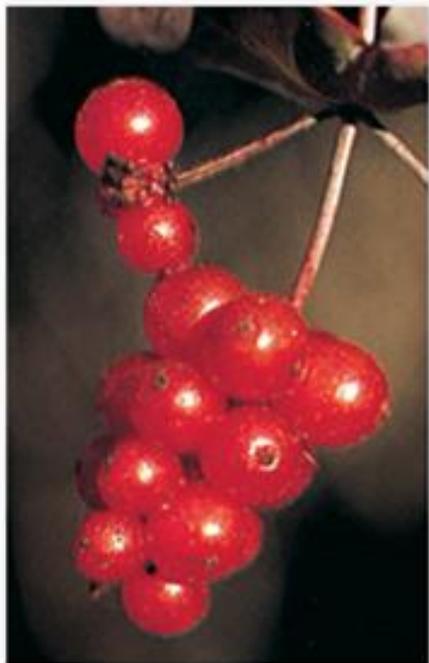
Individual flowers form fruits around a single stem. The fruits fuse as seen with pineapple.



Fruits made for Dispersal

Occurs through a wide array of methods

- Ingestion and transportation by birds or other vertebrates
- Hitching a ride with hooked spines on birds and mammals
- Blowing in the wind
- Floating and drifting on water



a.



b.



c.



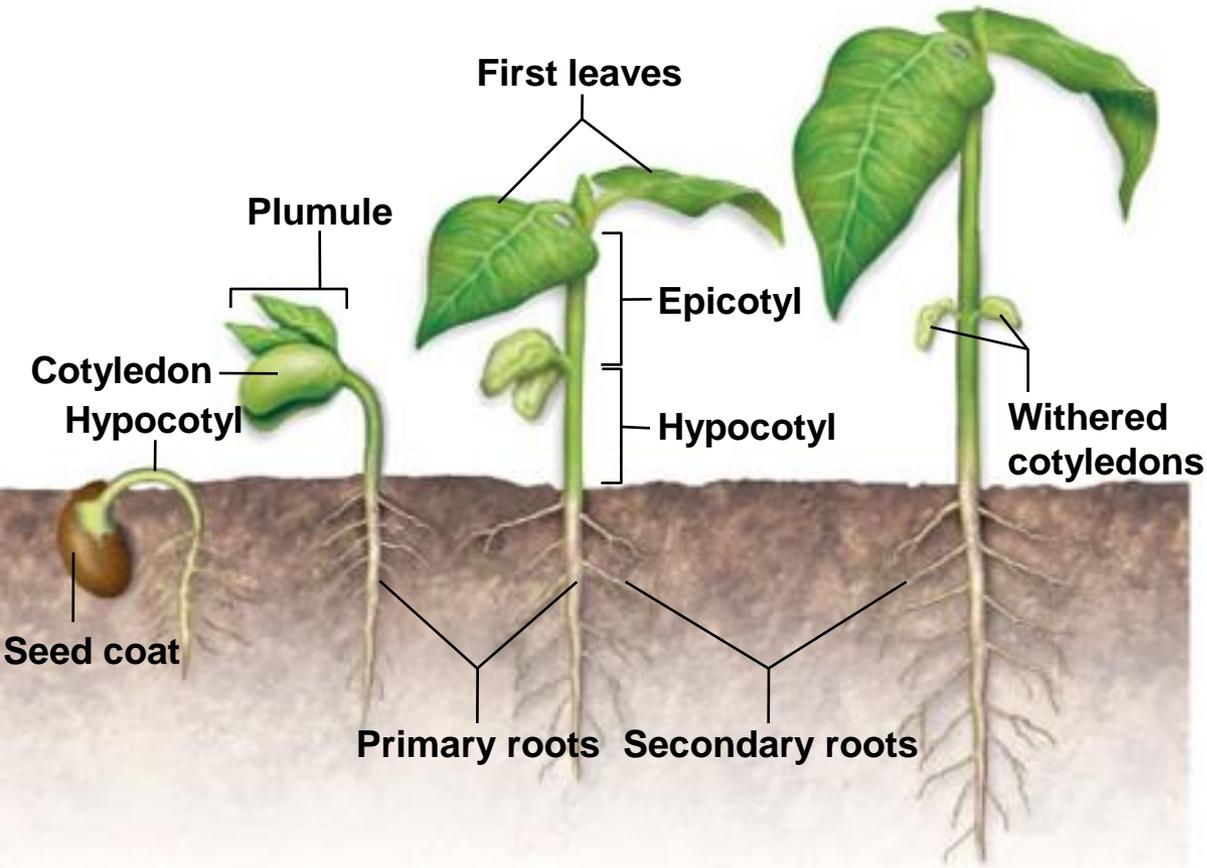
d.

Stages of Plant Development

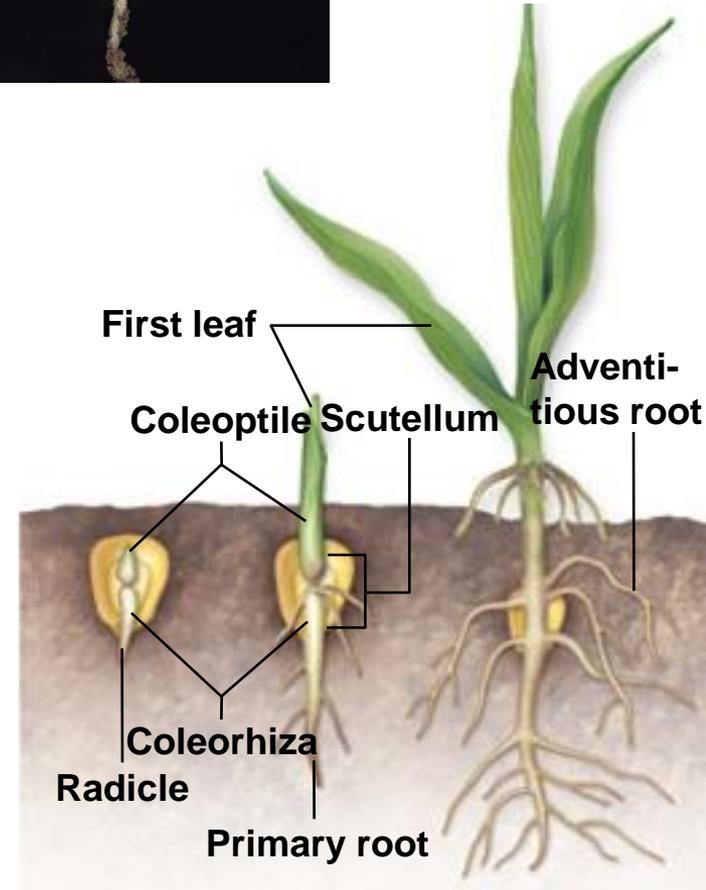
- **Germination**
 - Seed absorbs water & metabolism resumes
 - Need environmental cue (light, temp)



Bent hypocotyl



a.

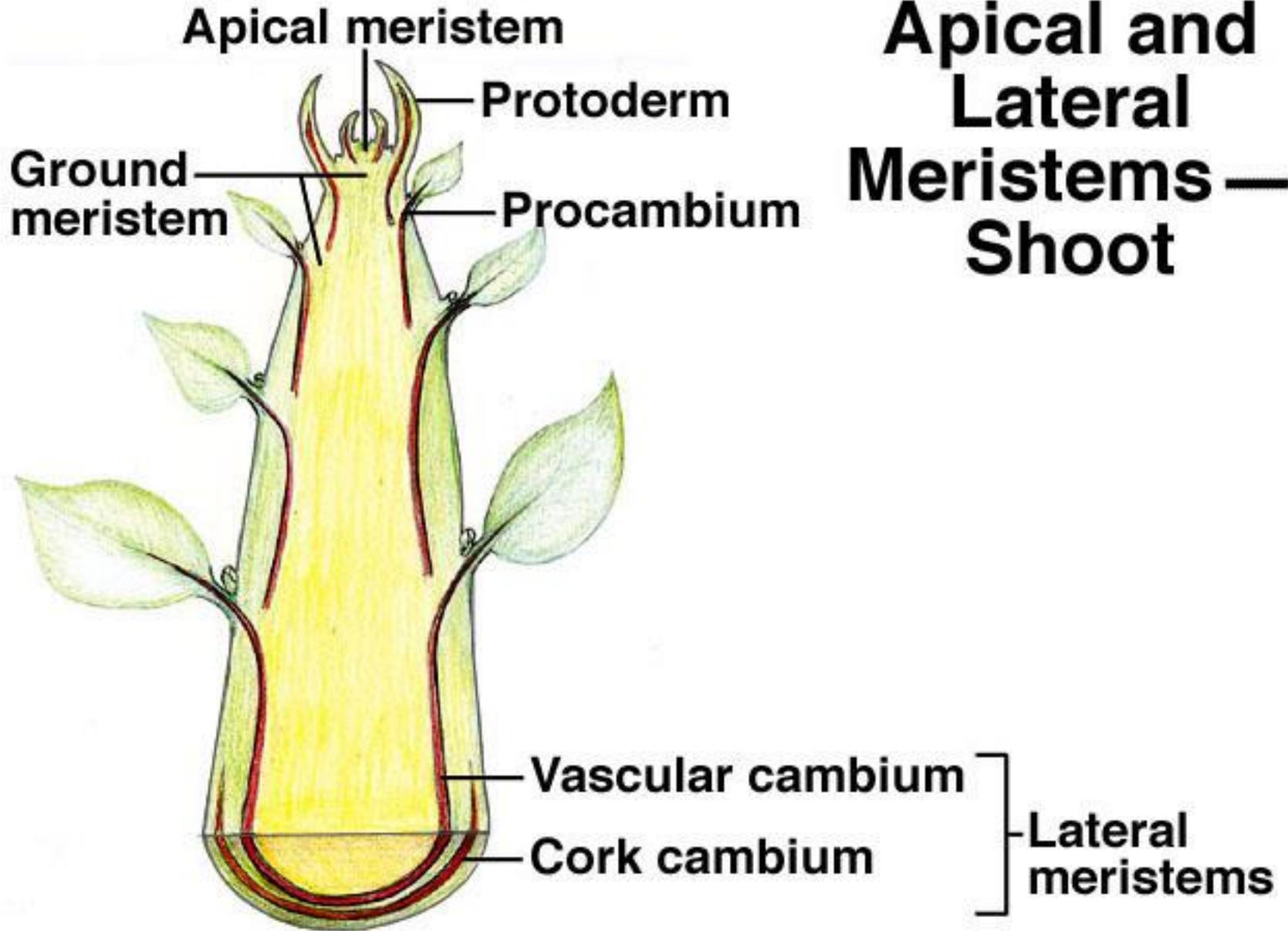


b.

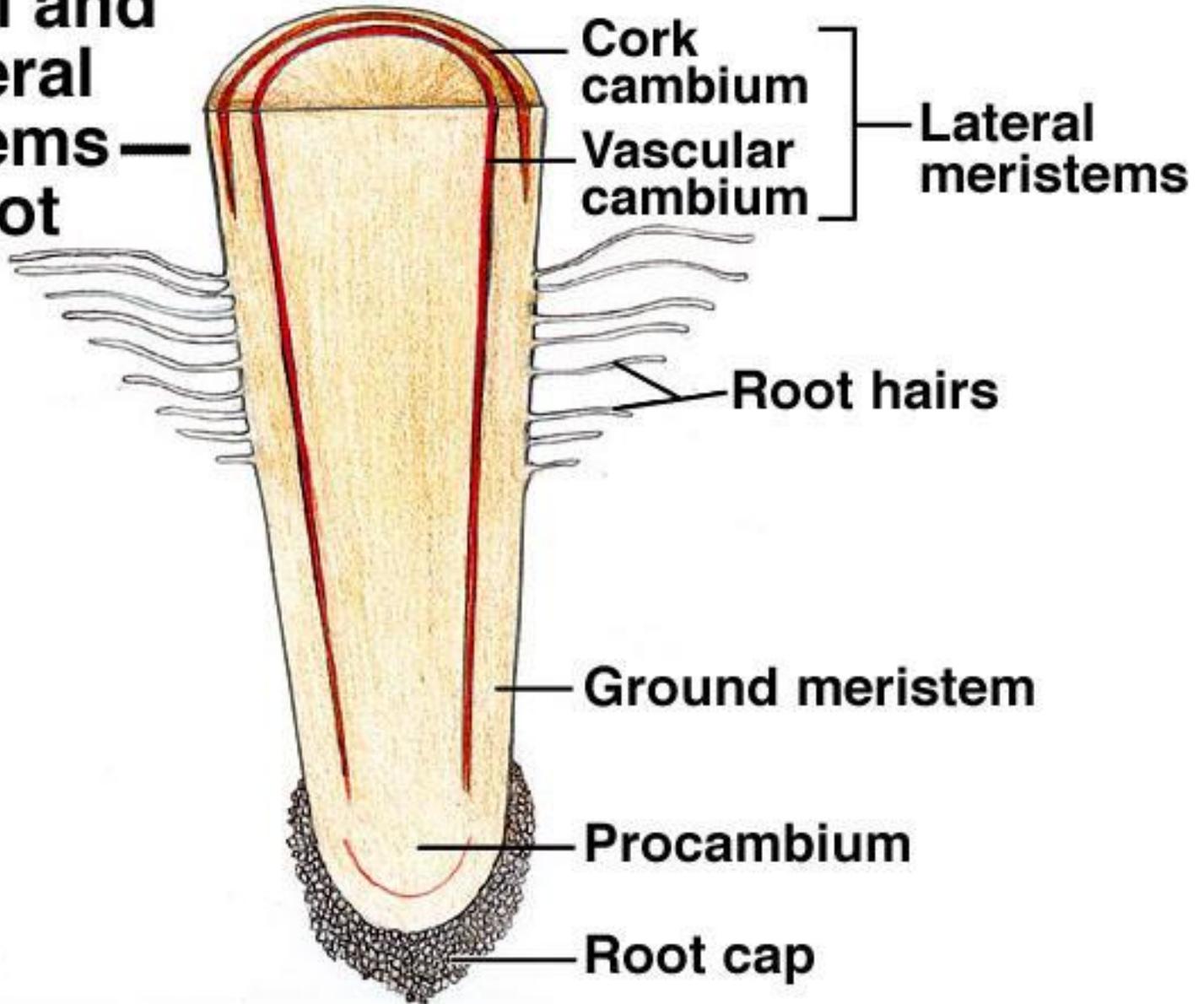
Stages of Plant Development

- **Meristematic Development**
 - Hormones influence meristematic activity
 - allow development to adjust to the environment
 - Body form determined by plane of cell division, cell shape & size

Apical and Lateral Meristems — Shoot



Apical and Lateral Meristems — Root



PLANT DEVELOPMENT

- Flexibility
- Plant bodies do not have a fixed size
 - Number & size of parts is influenced by environment