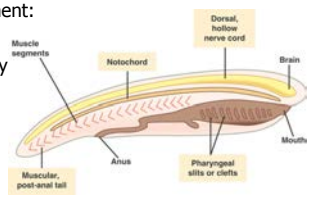
Phylum Chordata

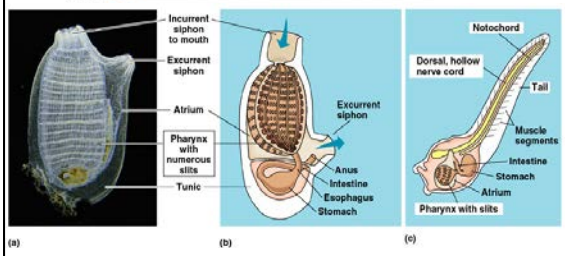
- Embryonic development:
  - Triploblastic
  - Bilateral symmetry
  - Eucoelomate
  - Deuterostome
- Special features:
  - **Notochord**
  - **Dorsal hollow nerve tube**
  - **Post-anal tail**
  - **Segmentation →**
    - **mesodermal blocs**
    - **pharyngeal arches and slits**



Phylum Chordata
— subphylum Protochordata

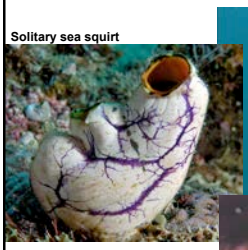
- Special features:
  - **No cephalization**
  - **pharyngeal arches and slits → ciliated atrium**
    - **Filter feeding & gas exchange**
  - **Open circulatory system**
  - **Metanephridia-type excretory system**
    (misidentified as protonephridia in most texts)
    and/or secretion into atrium
- Classes:
  - Urochordata
  - Larvacea
  - Cephalochordata

Urochordates – tunicates (sea squirts)



Pelagic colonial salp

Solitary sea squirt



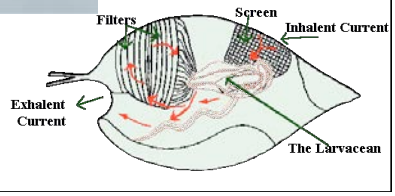
Wild convergence!
- Vertebrate like early development
- Mollusk-like bauplan
- Plant-like tunic
- Sponge-like or gelatinous final morphology

Colonial tunicate

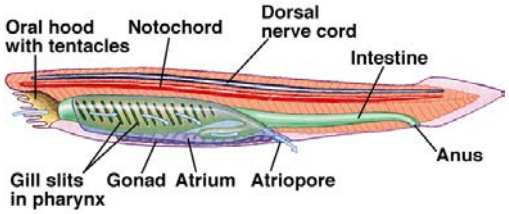
Larvaceans

- **External suspension feeding**
  - **Mucus "house"**
- **Reduced pharynx**

A Larvacean in its House



Cephalochordates - lancelets



Phylum Chordata
— subphylum Vertebrata (Craniata)

- Special features:
  - Prolonged embryonic development
  - Strong cephalization
    - Brain in cranium
  - mesodermal blocs →
    - Myomeres & vertebrae
  - Closed circulatory system
- **Agnathans** — jawless vertebrates
- **Gnathostomes** — jawed vertebrates
  - **Fishes** — axial skeleton only
  - **Tetrapods** — axial + appendicular skelton

Axial skeleton of a bony fish

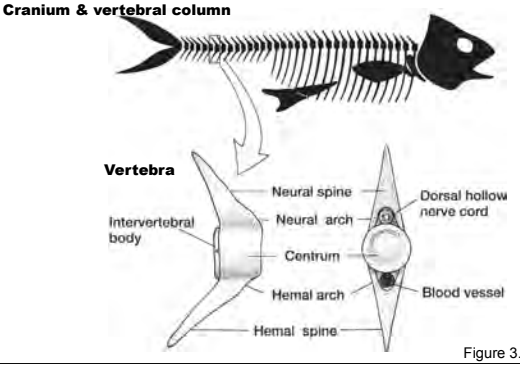


Figure 3.02

Axial & appendicular skeleton of a bipedal tetrapod

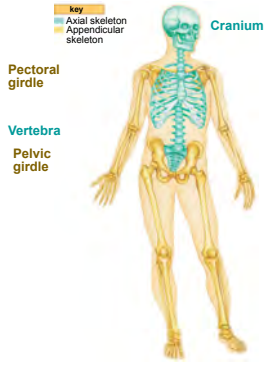
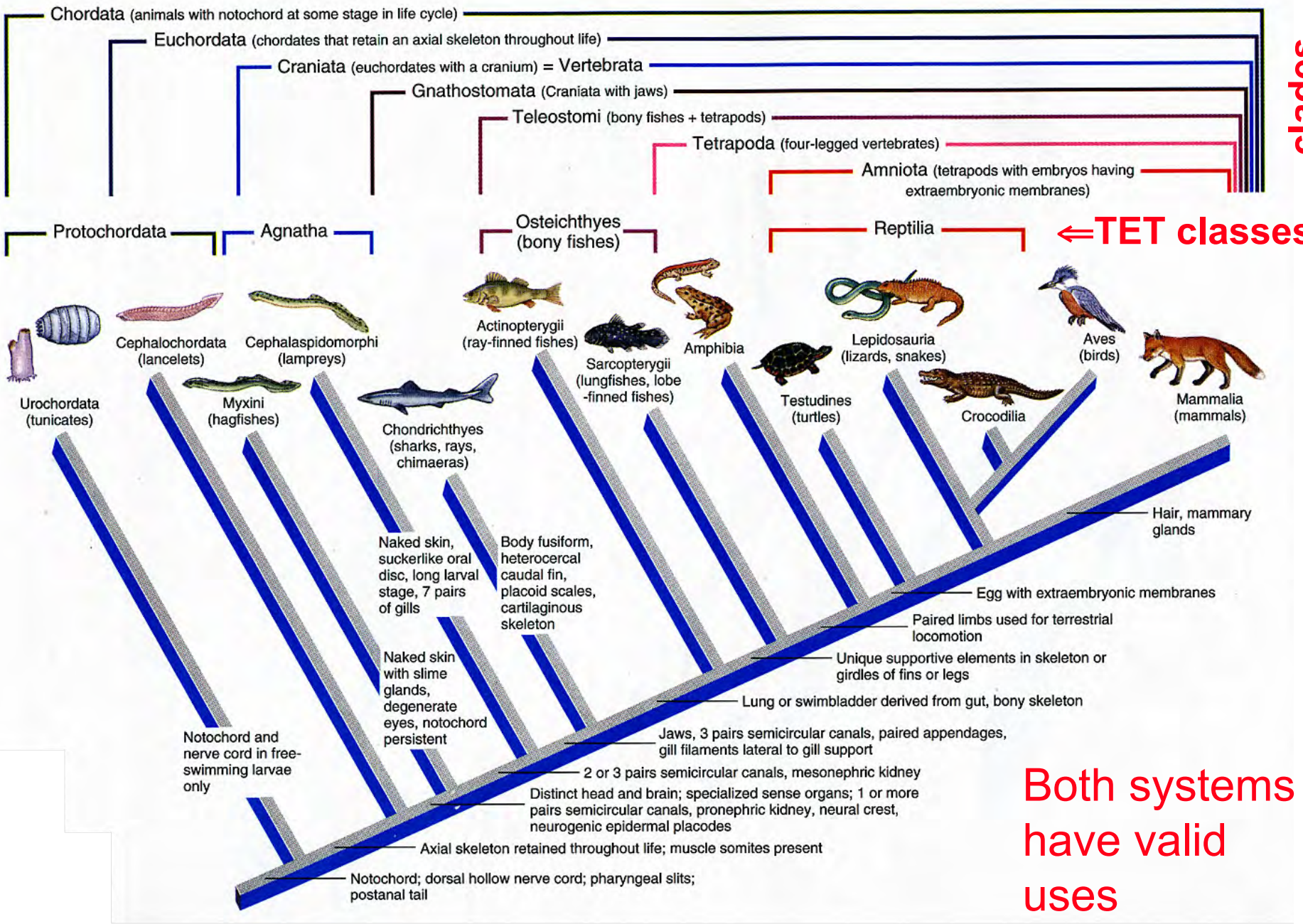


Figure 49.26

Phylum Chordata
— subphylum Vertebrata (Craniata)

- Classes:
  - –Agnatha — jawless fishes
  - –Chondrichthyes — cartilaginous fishes
  - –Osteichthyes — bony fishes
  - –Amphibia
  - –Reptilia
  - –Aves — birds
  - –Mammalia

Chordate Systematics



Both systems have valid uses

Vertebrate Development

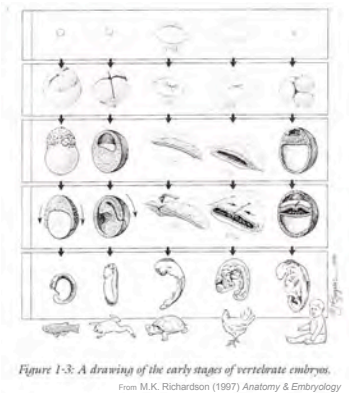
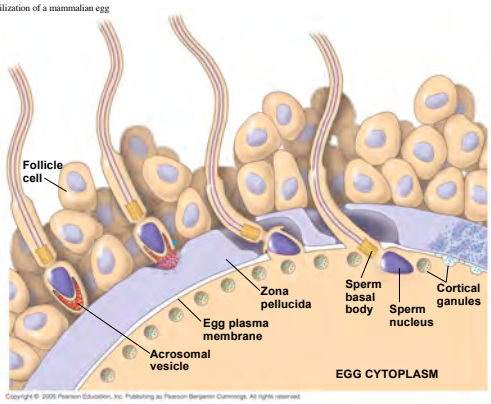


Figure 1-3: A drawing of the early stages of vertebrate embryos.

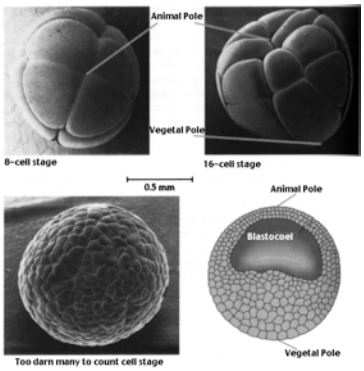
From M.K. Richardson (1997) *Anatomy & Embryology*

Fertilization of a mammalian egg

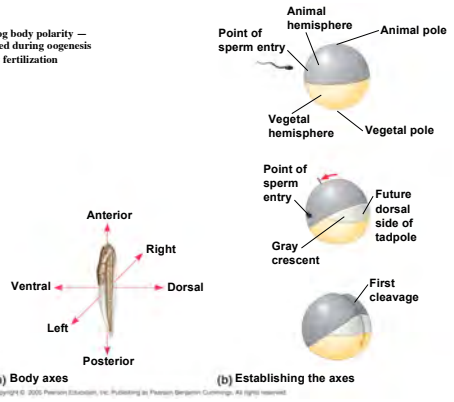


Radial Cleavage & Blastulation — Frog

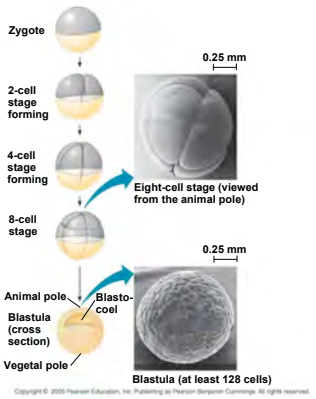
- Large yolk content necessitates asymmetrical blastulation



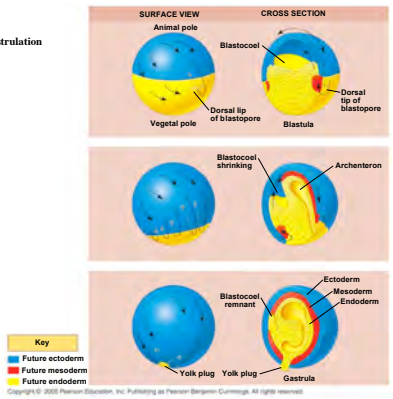
47-8: **Frog body polarity — established during oogenesis & fertilization**



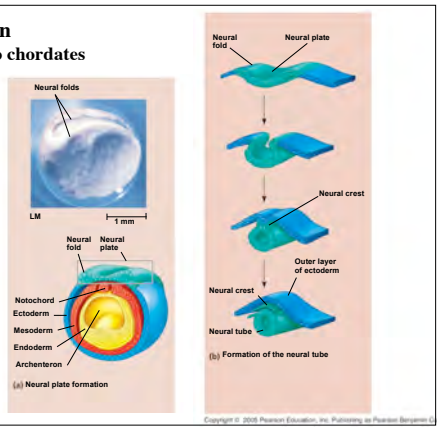
47-9: **Frog body polarity — Cleavage planes**



47-12: **frog gastrulation**

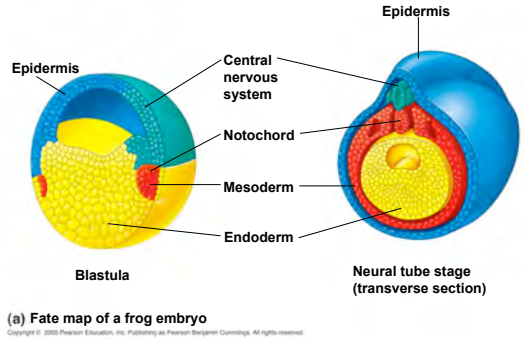


Neurulation
— unique to chordates



47-14: **frog neurulation**

47-23a: **frog fate map**

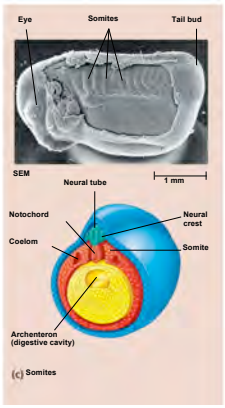


(a) Fate map of a frog embryo

chordate segmentation

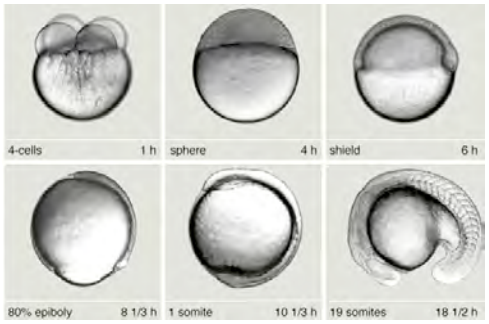
Mesoderm lateral to the notochord forms blocks called **somites**

Lateral to the somites, the mesoderm splits to form the coelom



47-14c: **frog segmentation**

Fish Development

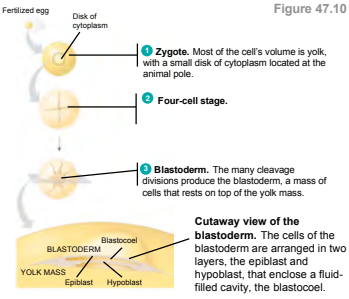


Source: http://www.ucalgary.ca/UofC/eduweb/virtualembryo/why_fish.html

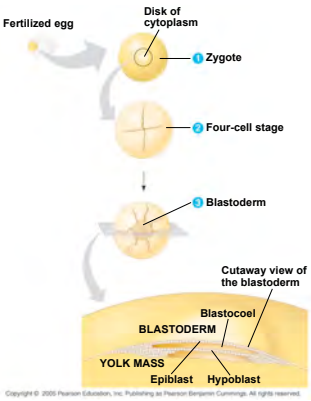
Another way — asymmetric blastulation in many vertebrates

- Large, yolk-rich eggs
- Cleavage forms the **blastoderm**.
- Separation of the epiblast from the hypoblast forms the blastocoel.

Figure 47.10



47-10: **Chick cleavage**



Gastrulation — Chick

- Instead of blastopore, groove (primitive streak) forms in blastoderm.
- All three germ layers form from infolding epiblast.

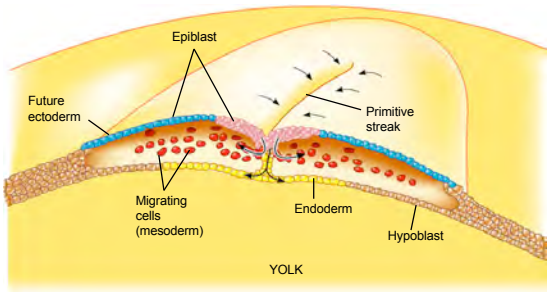
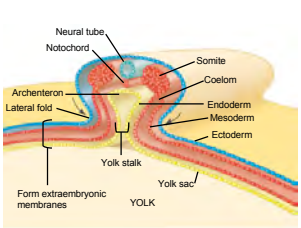


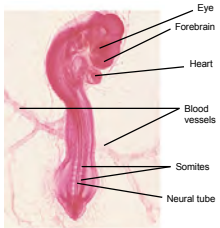
Figure 47.13

Gastrulation — Chick

- Organogenesis from germ layers.



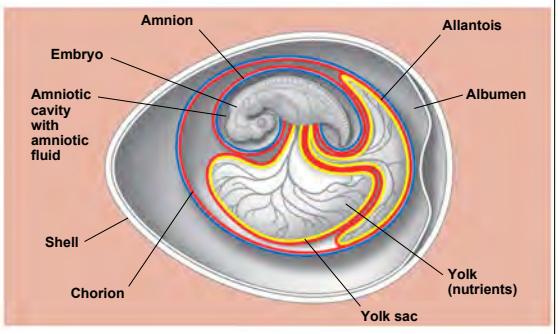
(a) Early organogenesis. The archenteron forms when lateral folds pinch the embryo away from the yolk.



(b) Late organogenesis. 56 hours old chick embryo, about 2–3 mm long (LM).

Figure 47.15

chick extra-embryonic membranes (amniote)



47-17: **chick extra-embryonic membranes**