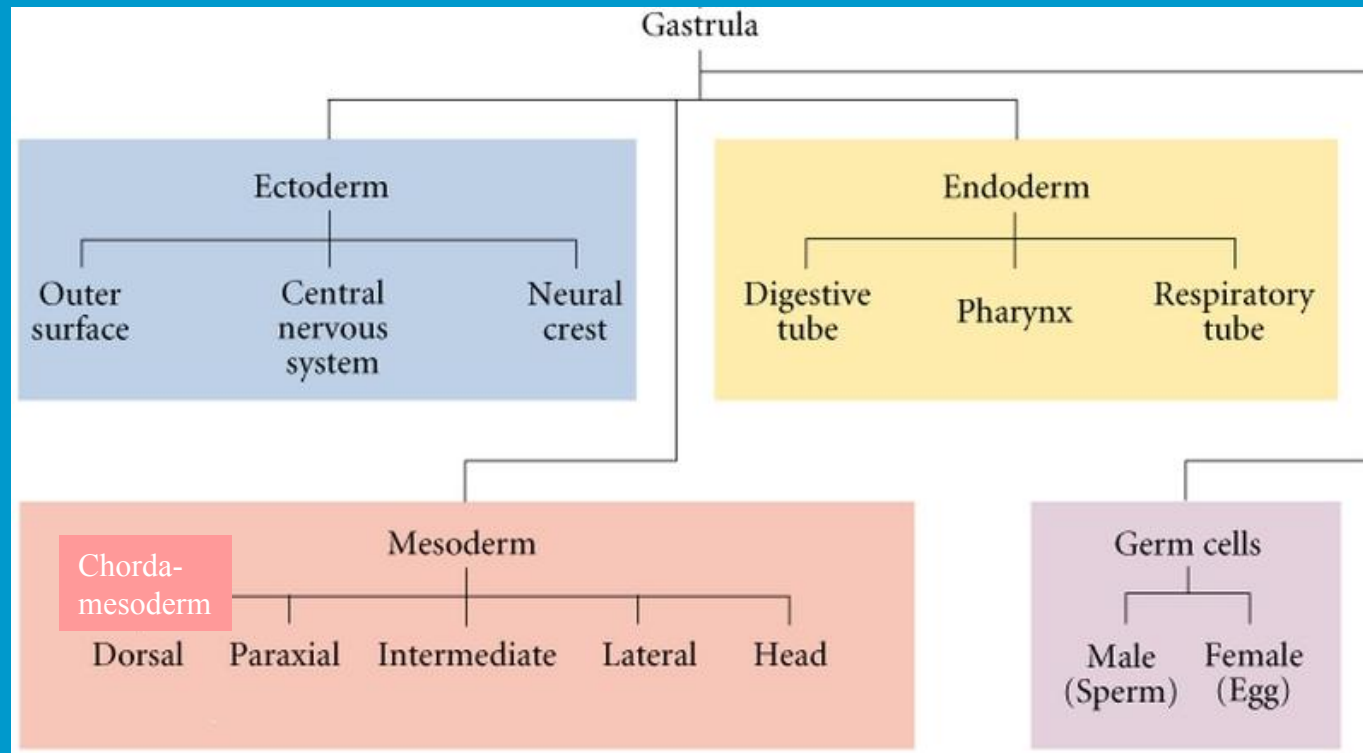


# Mesoderm I

# Some Mesodermal Derivatives



notochord

skeletal muscle

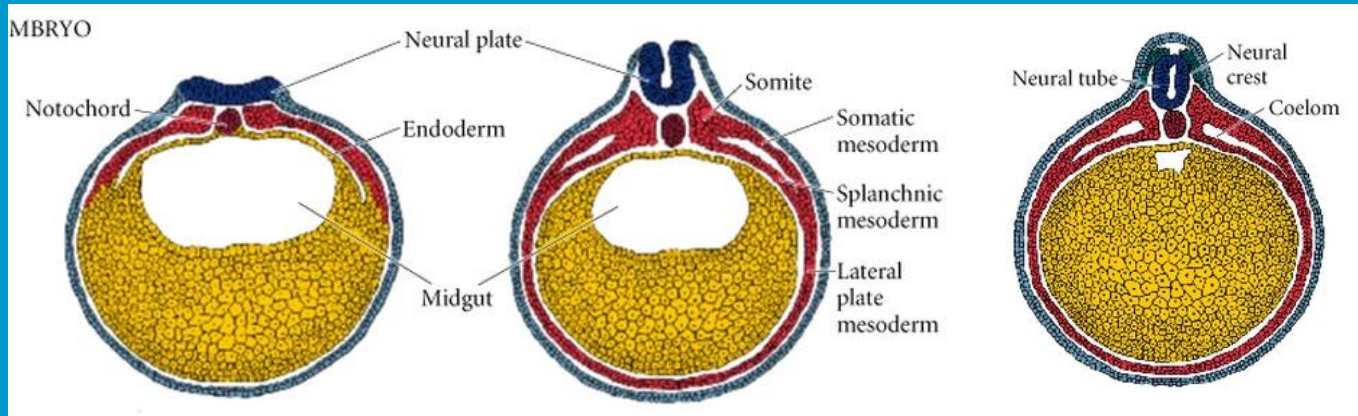
kidney

blood cells

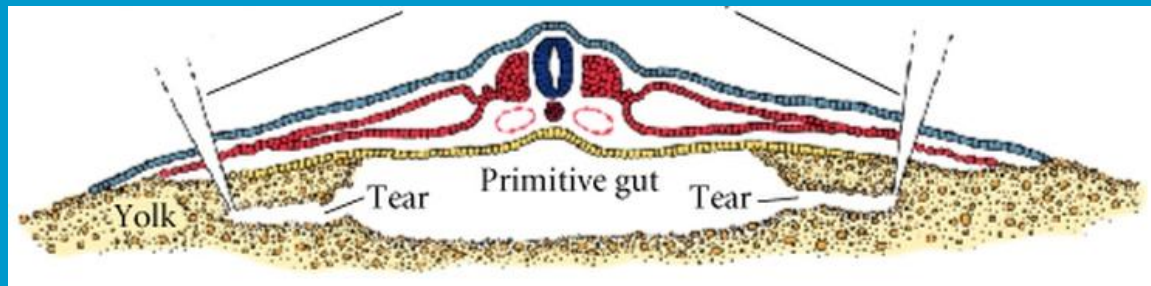
facial muscle

# Anatomy of Trunk in Frog and Chick

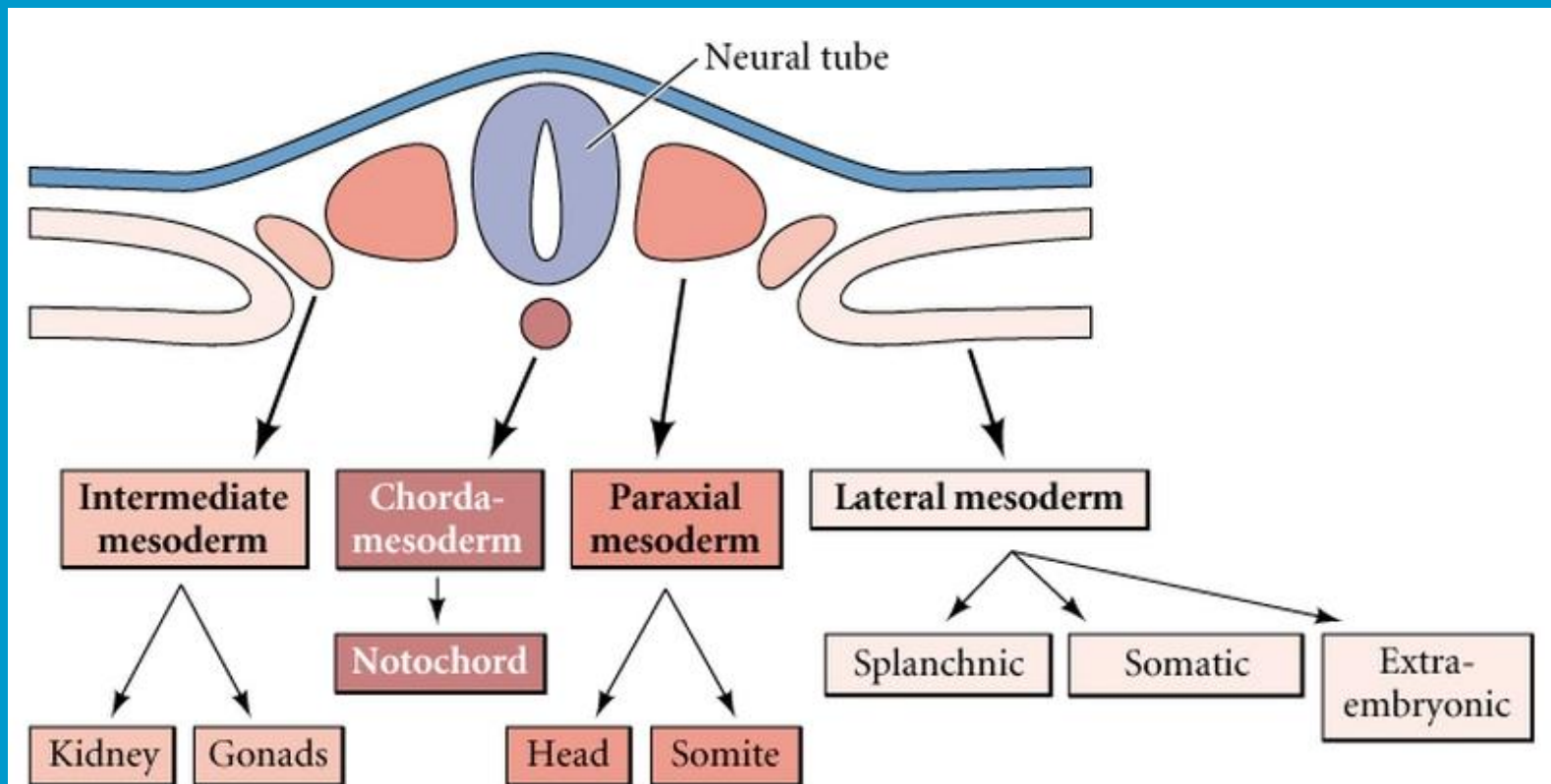
## Frog



## Chick

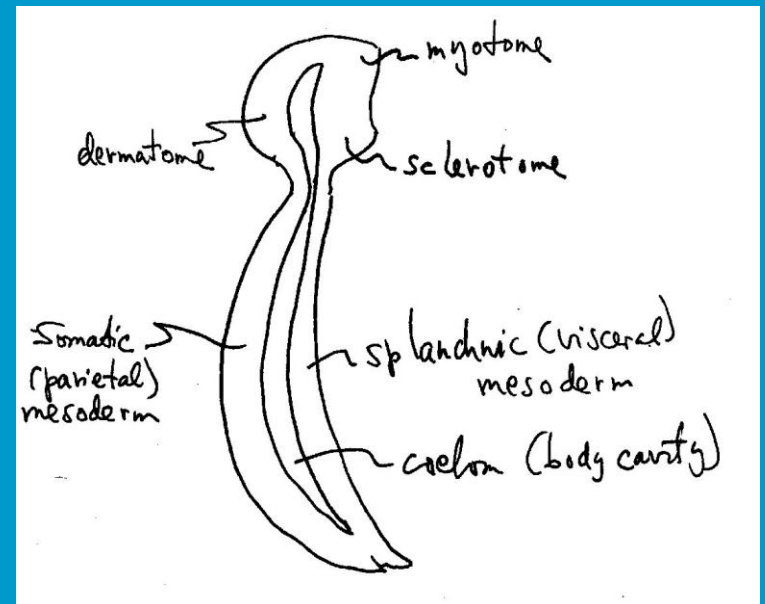
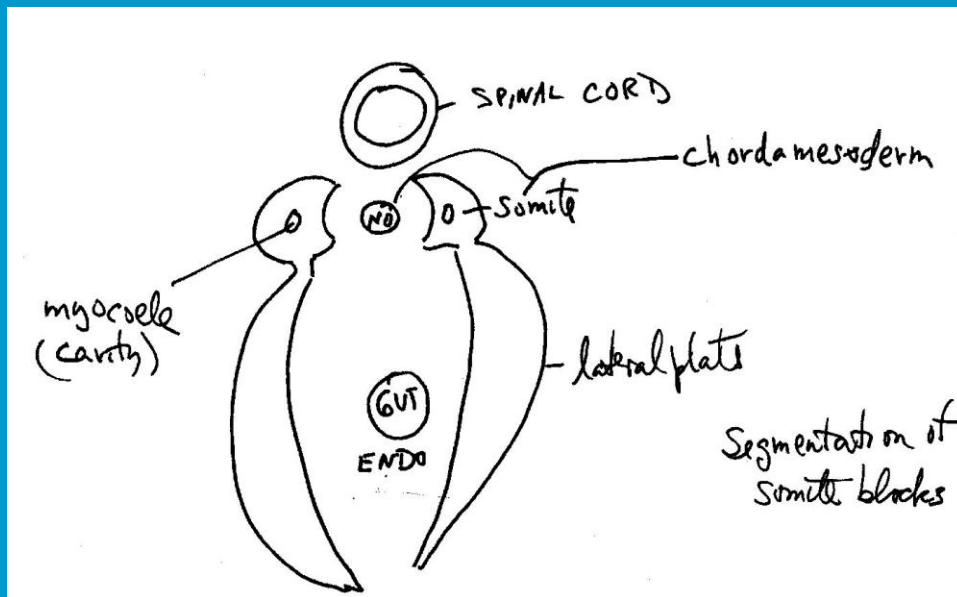


# Spatial Relationships of Major Lineages of the Mesoderm



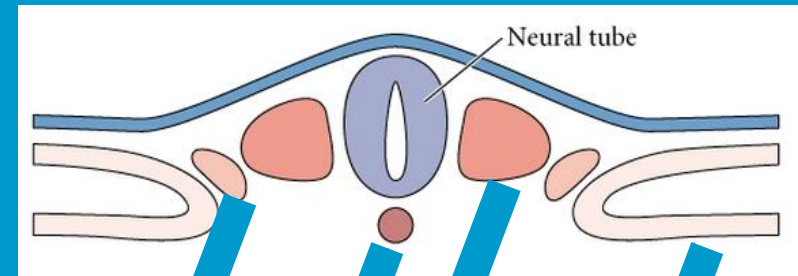
# Early Subspecializations of Trunk Mesoderm

- Somites segment into blocks
- Lateral plate and somites split (form coelom)



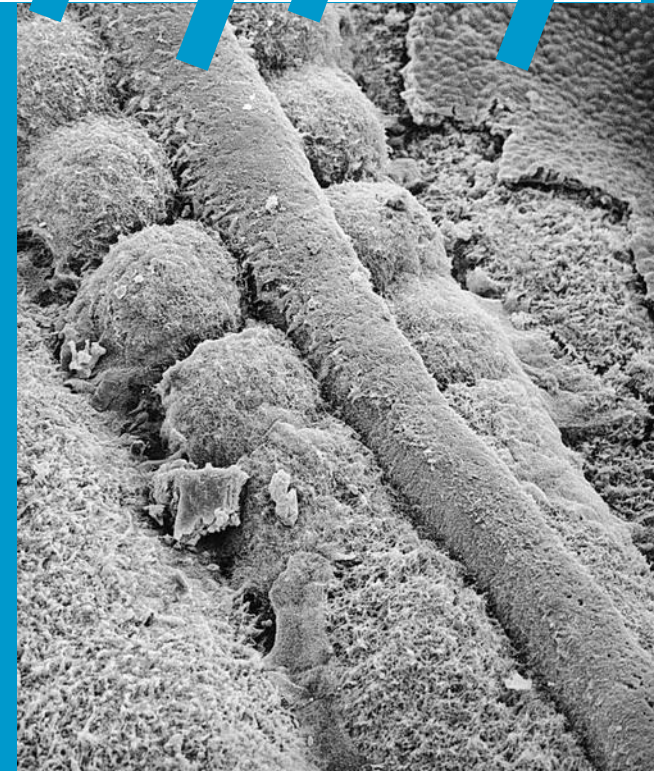
Transverse sections

# Paraxial Mesoderm



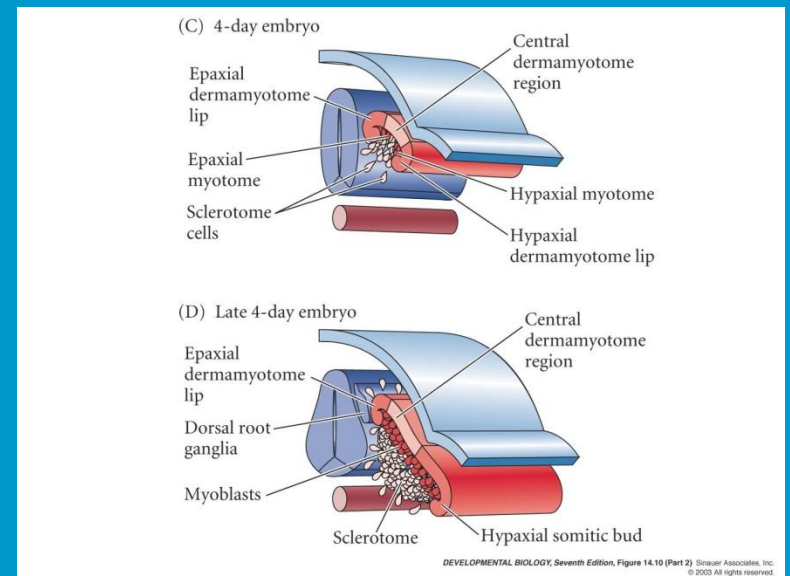
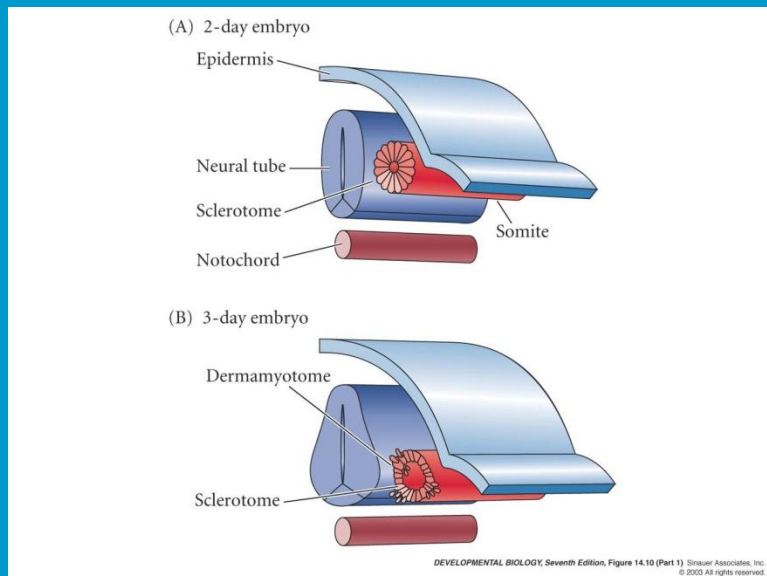
- Separates into blocks of cells:  
“somites”

- Transient structures
- Organize the segmental pattern of vertebrate embryos
- Determine migration path of neural crest cells and spinal nerve axons
- Form vertebrae, ribs, and the skeletal muscles of the back, body wall, and limbs



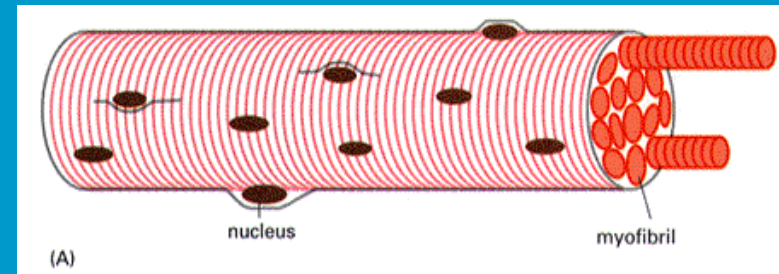
# Somitic Regions

- *Dermatome* --> dermis of back (connective tissue)
  - Other dermis comes from other mesenchymal cells (non-somite)
- *Myotome* --> trunk and limb muscles
  - Somatic (striated) muscle
- *Sclerotome* --> cartilage (replaces notochord)
  - bone of vertebrae and ribs



# Differentiation of Skeletal Muscle Cells

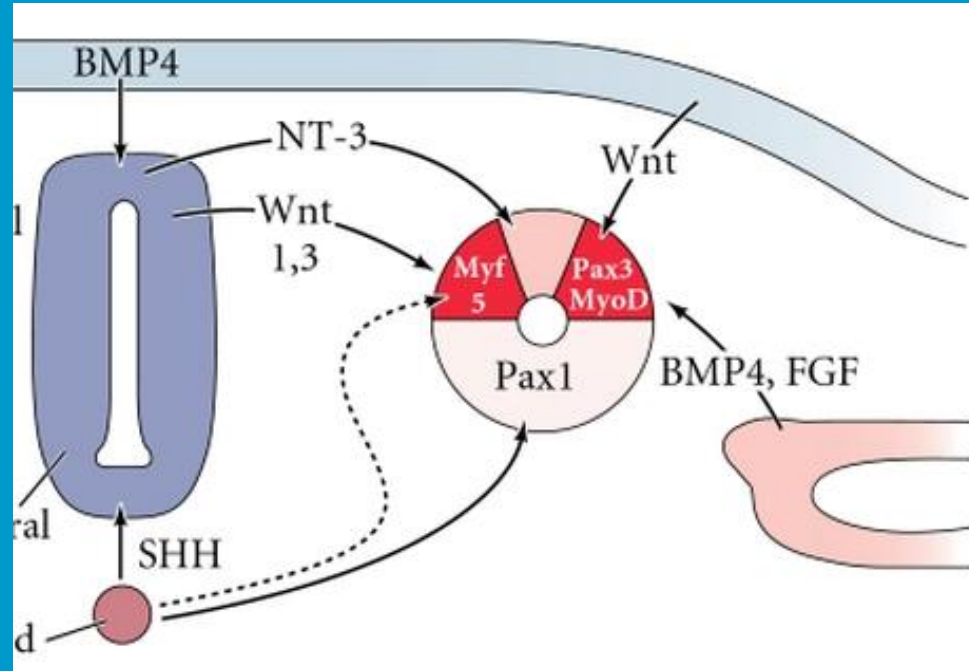
- Muscles
  - Skeletal muscle
    - from myotome of somites
  - Involuntary muscles (smooth muscle and cardiac muscle)
    - from mesodermal lateral plate
- Muscle fibers are made of multinucleated muscle cells
  - 0.05mm diameter in humans
  - Myofibril = contractile unit
    - actin and myosin





# How is the Myotome Specified?

- Paracrine factors signal the myotome precursors to express MyoD, Myf5
- Muscle-specific genes are activated
- Myoblasts = committed muscle cell precursors



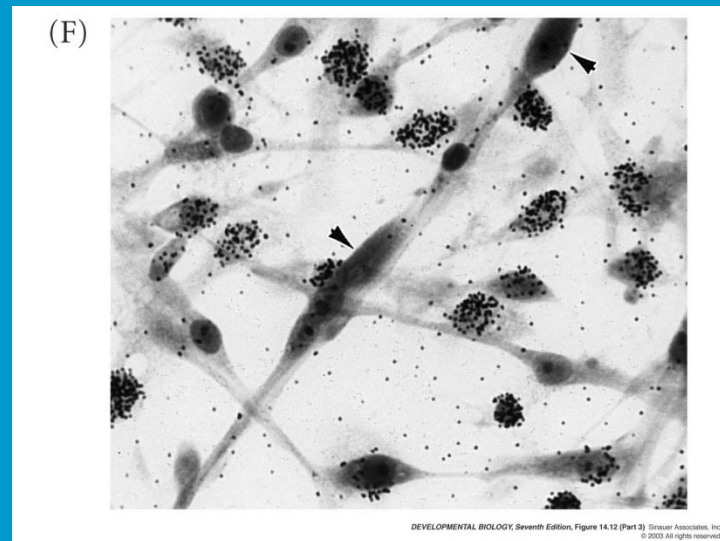
from spinal chord, notochord,  
lateral plate, epidermis

# MyoD

- MyoD and other related transcription factors control determination
  - Only expressed in muscle lineage
- Transfect in other cell types turns them to muscle in culture
- Knockout both myoD and myf5
  - kills muscle precursor cells but either can give muscle determination (redundant)

# Models for Myotube Formation

- How could you make multinucleate cells?
  - Nuclear division without cell division
  - Fusion of multiple cells



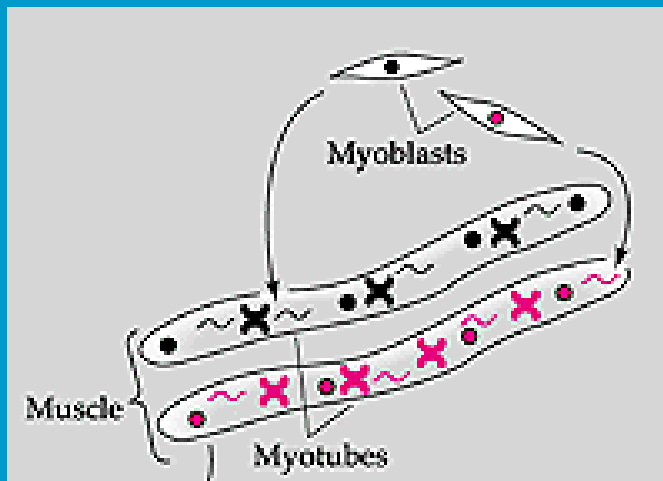
Myoblasts into myotubes

# Models for Myotube Formation

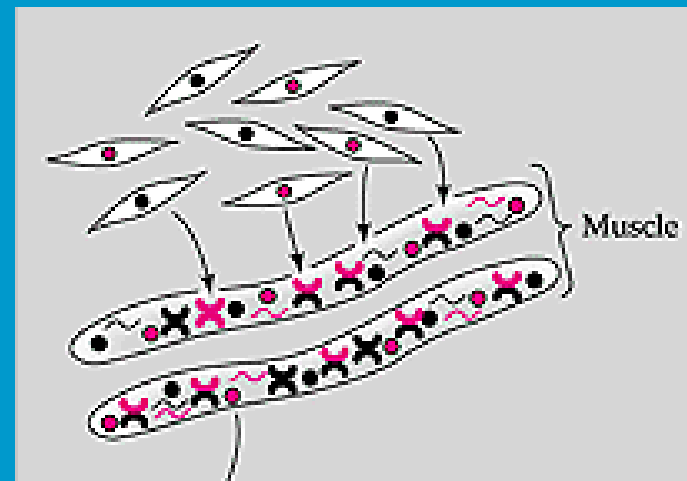
- Division Model

- Fusion Model

(A) Division model



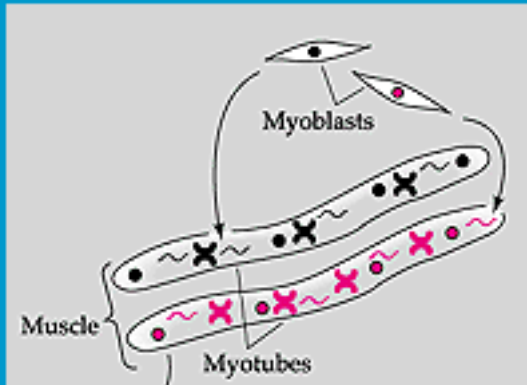
(B) Fusion model



# How Can We Choose?

- Division Model

(A) Division model



- Fusion Model

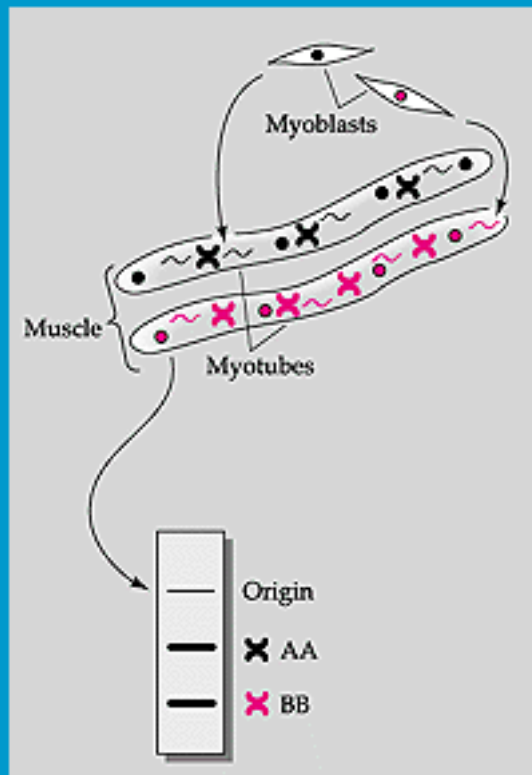
(B) Fusion model



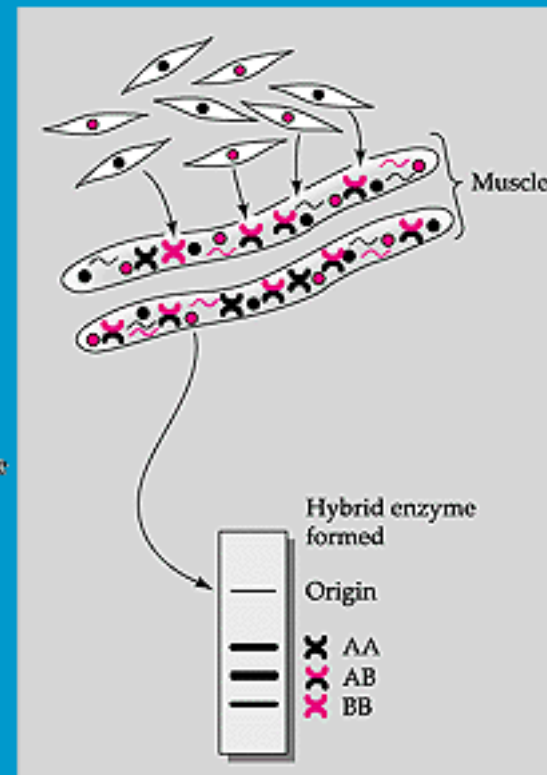
- To distinguish: start with embryos derived from fusion of embryonic cells from 2 different mice strains (genotypes) encoding different enzymes
  - Genotype AA --> protein A --> enzyme AA
  - Genotype BB --> protein B --> enzyme BB

# How to Detect Different Isozymes?

- Division Model



- Fusion Model

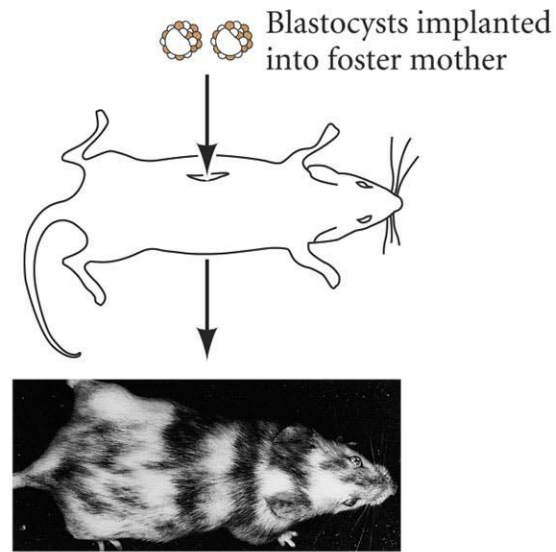
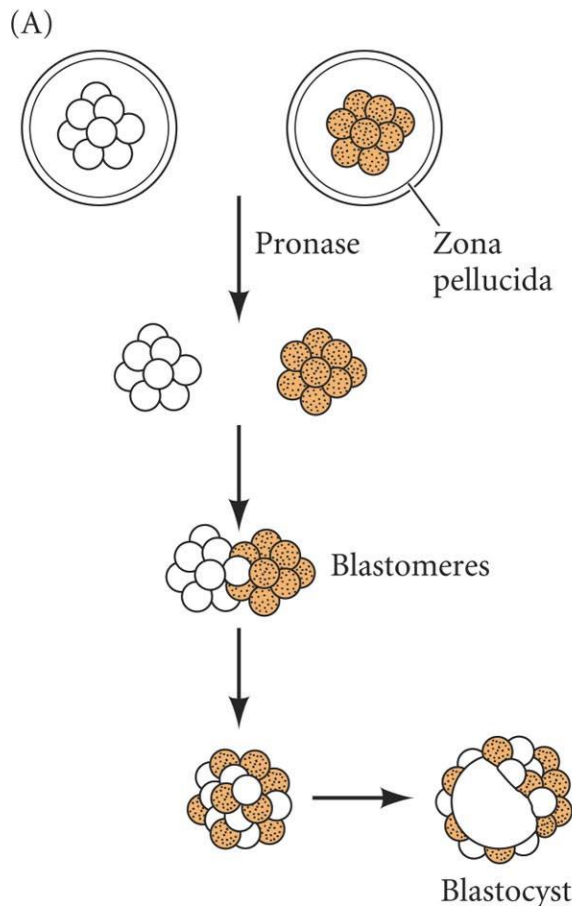


Homogenize and place at origin of electrophoresis plate

Isocitrate dehydrogenase enzymes seen by electrophoresis

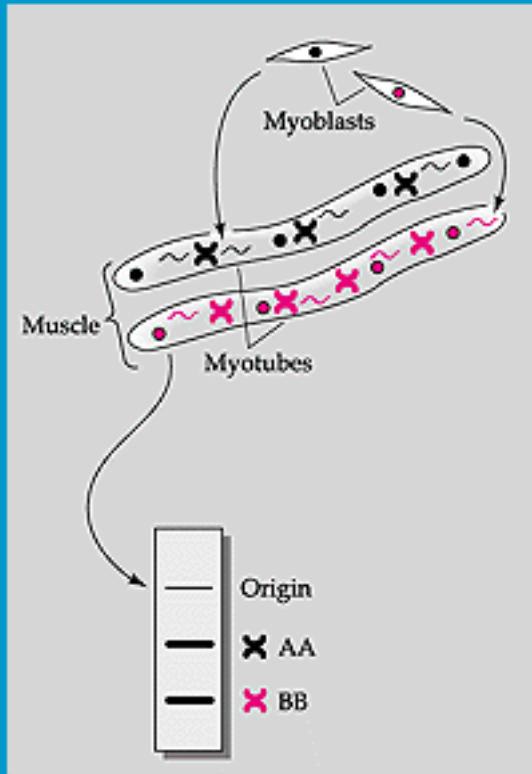
Hybrid enzyme formed

# How To Do This in a Living Organism: The Tetraparental Mouse

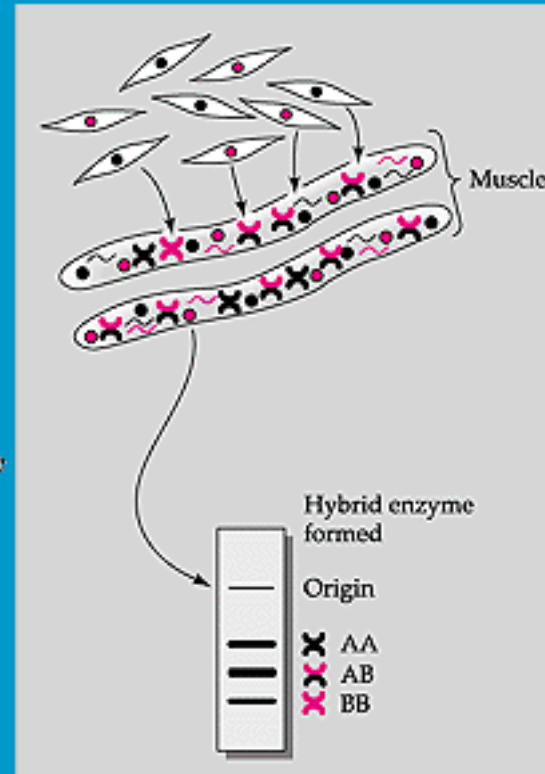


# Result

- Division Model



- Fusion Model



Homogenize and  
place at origin of  
electrophoresis plate

Isocitrate  
dehydrogenase  
enzymes seen by  
electrophoresis

Hybrid enzyme  
formed

- All tissues  
(including heart muscle)

skeletal muscle



# Where Does Skeletal Tissue Arise?

- Axial skeleton (from somites)
- Limb skeleton (from lateral plate mesoderm)
- Branchial arches and cranofacial bones (from neural crest cells)

