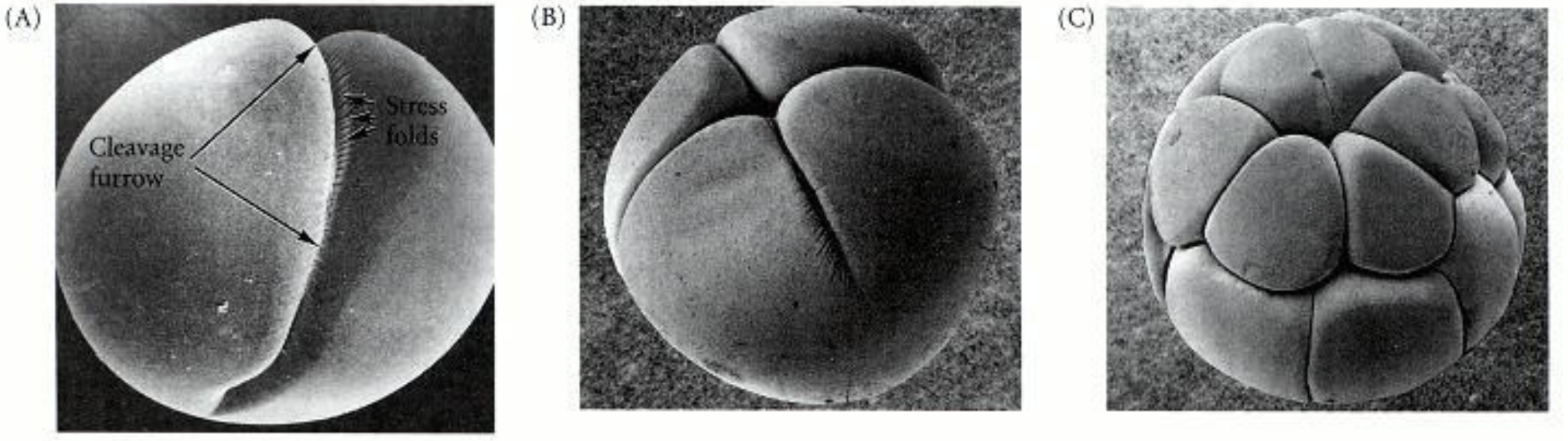
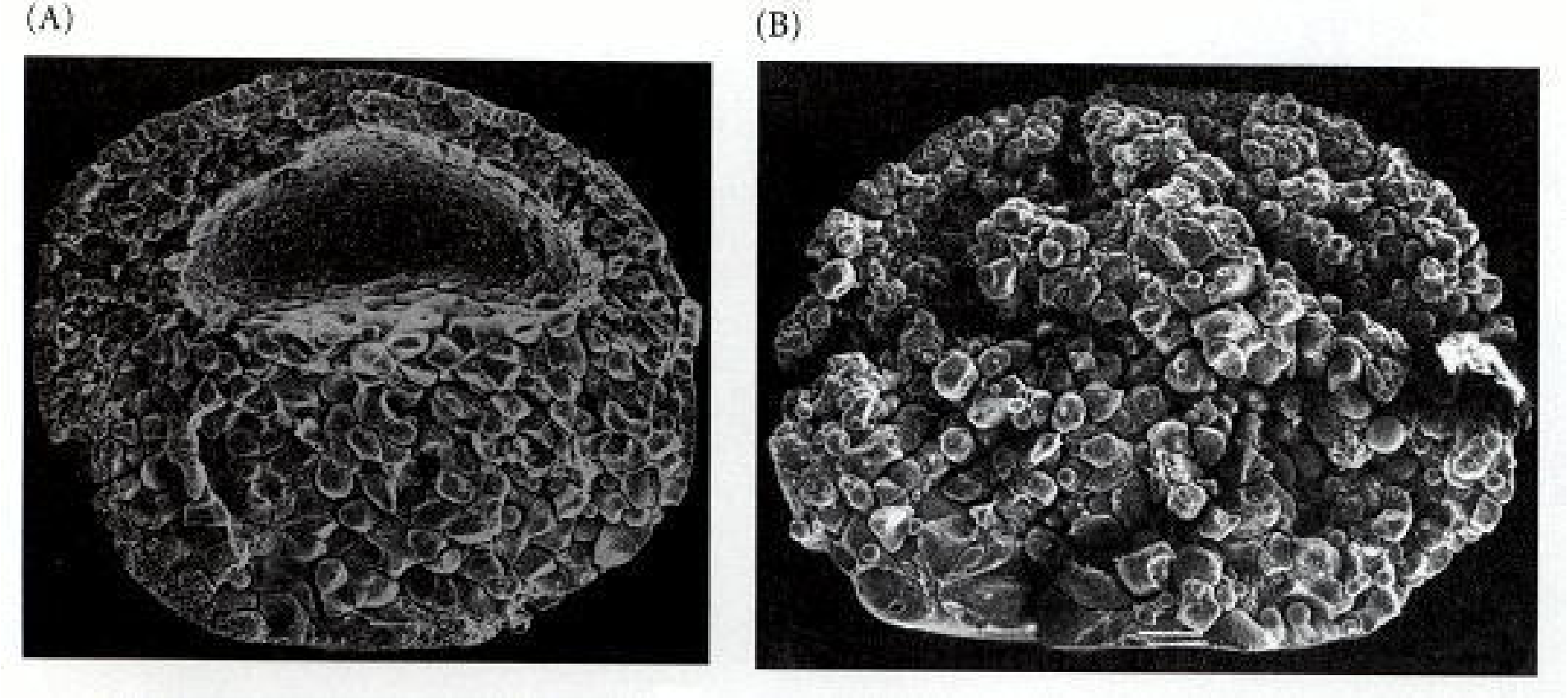
Cleavage



EP-cadherin

- Cell adhesion molecule
- Helps hold together blastomeres
- Translated from mRNA deposited in oocyte

EP-cadherin necessary for cell adhesion

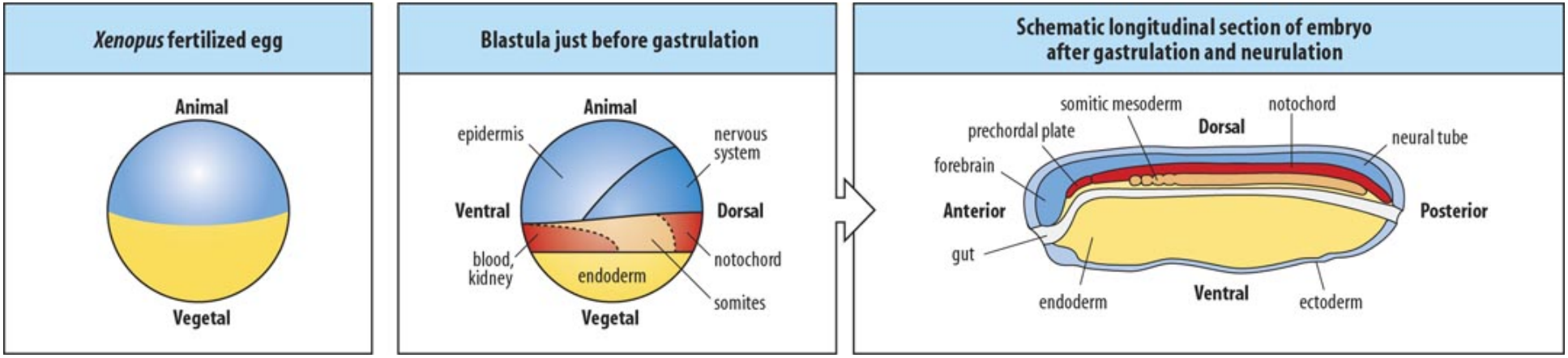


- Oocyte was treated with anti-sense RNA's against EP-cadherin mRNA

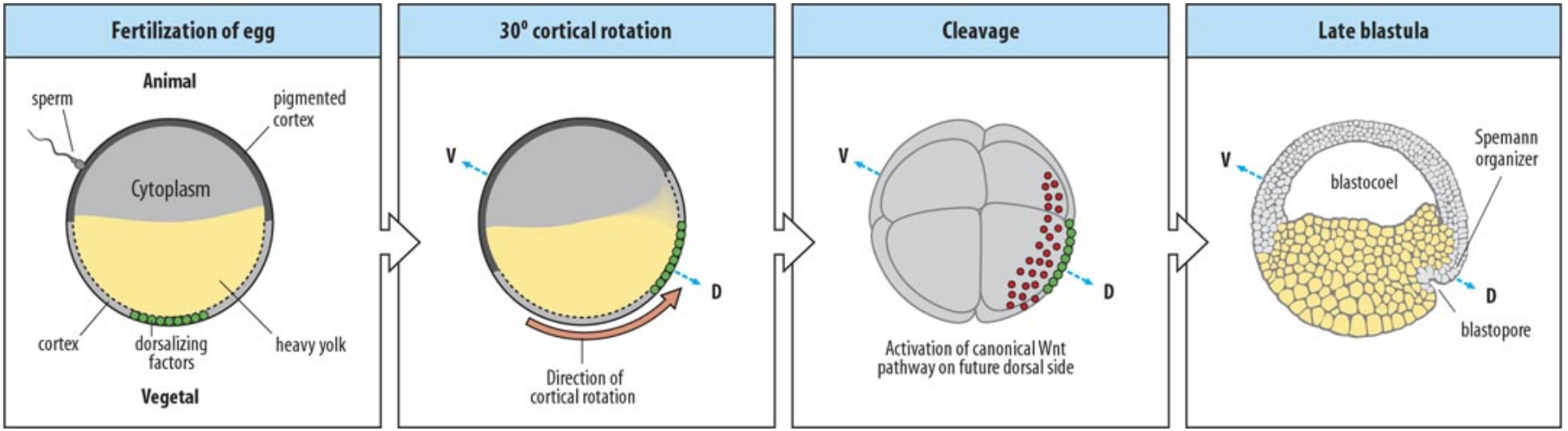
Amphibian Axis

- Animal hemispheres will become ectoderm
- Vegetal hemispheres will become endoderm
- Equatorial region will become mesoderm

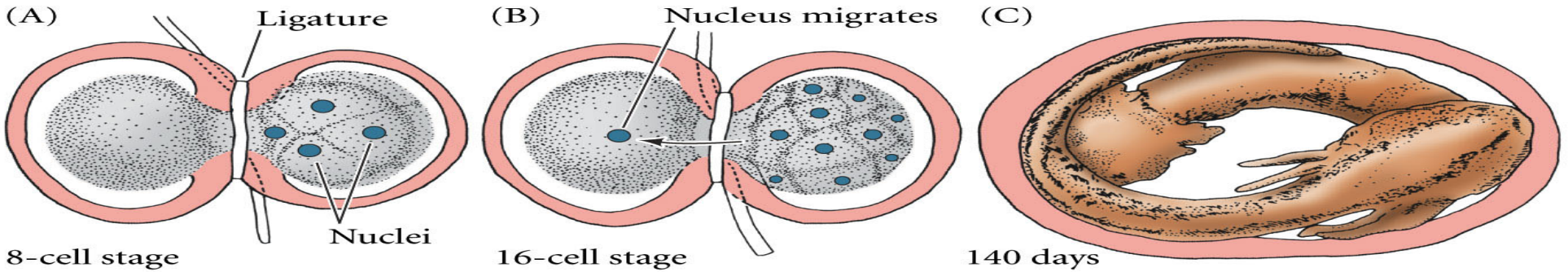
Early Fate Map



Movement of Dorsalizing Factors



Spemenn's Experiment



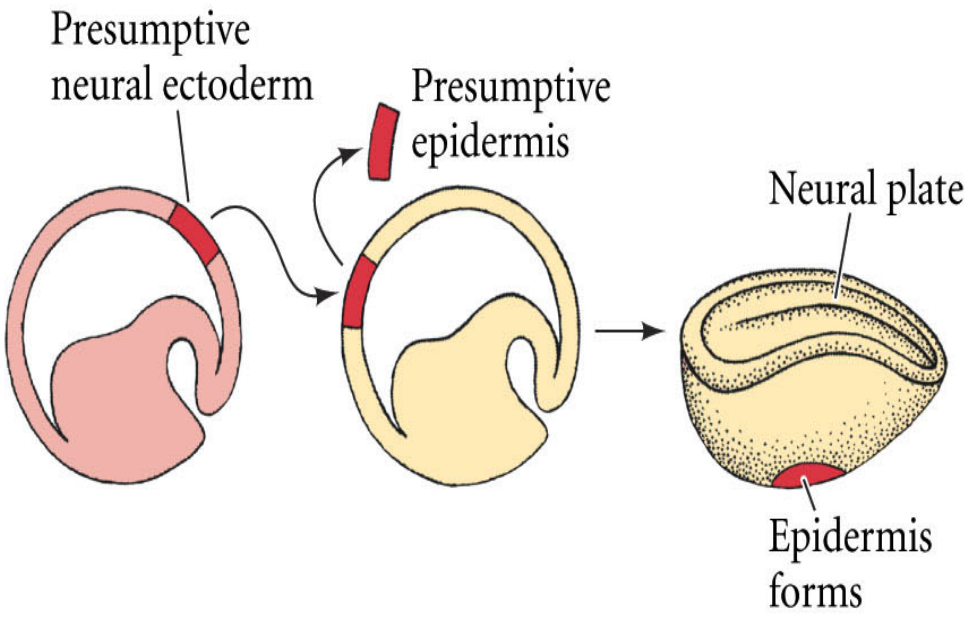
Early nuclei are equivalent.

Spemann transplantation experiments

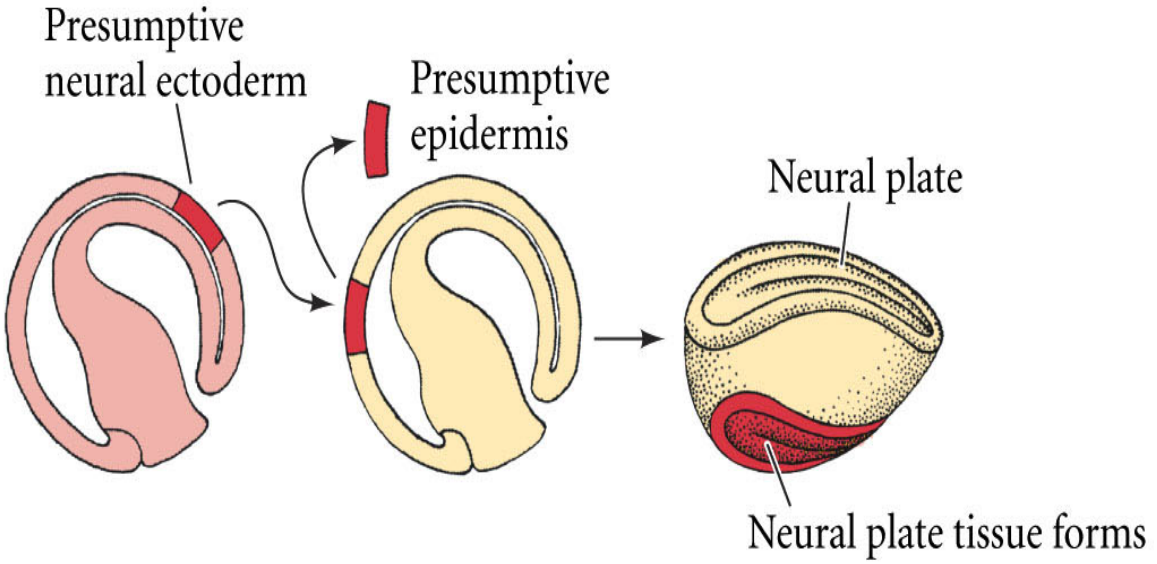
Early gastrula cell fate not determined

Late gastrula cell fate determined

(A) TRANSPLANTATION IN EARLY GASTRULA

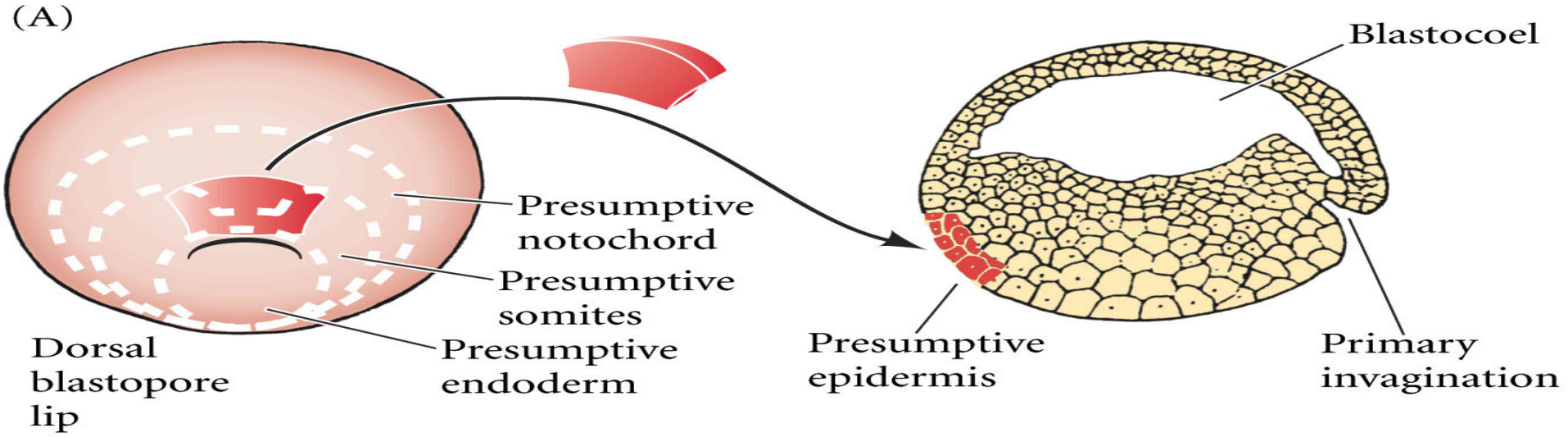


(B) TRANSPLANTATION IN LATE GASTRULA

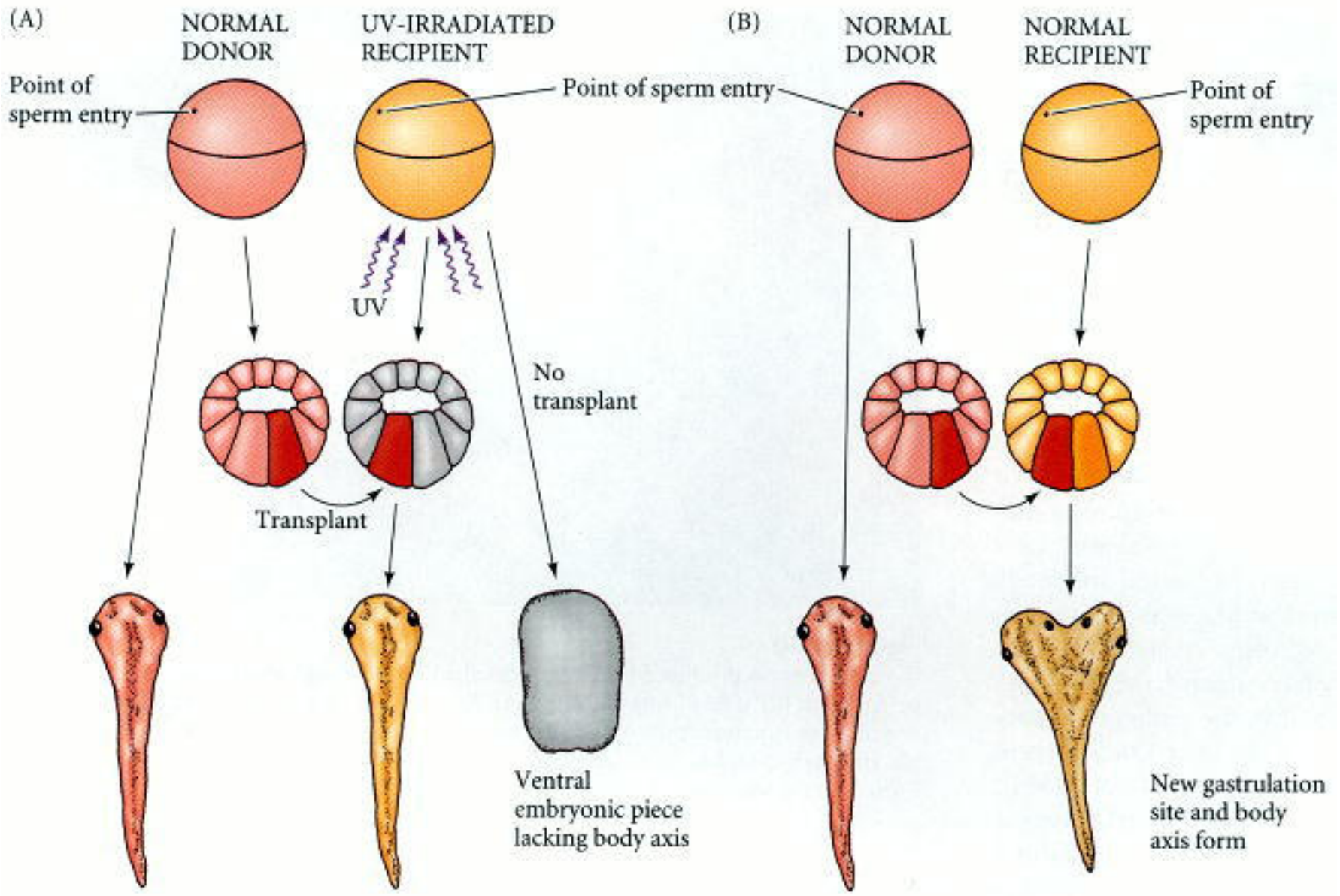


The Organizer

Dorsal lip induces formation of dorsal structures.

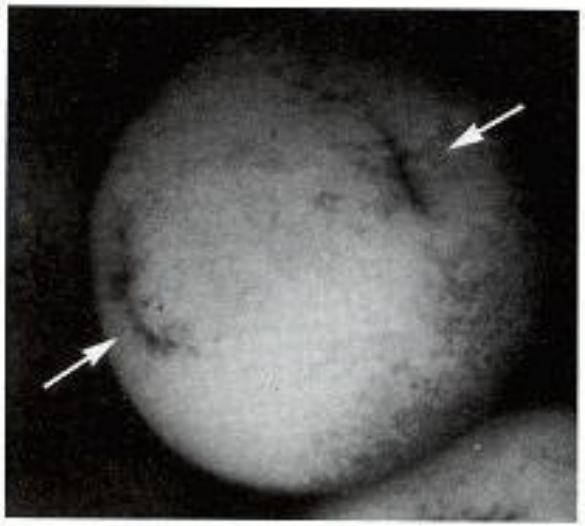


Vegetal Cell Transplantation

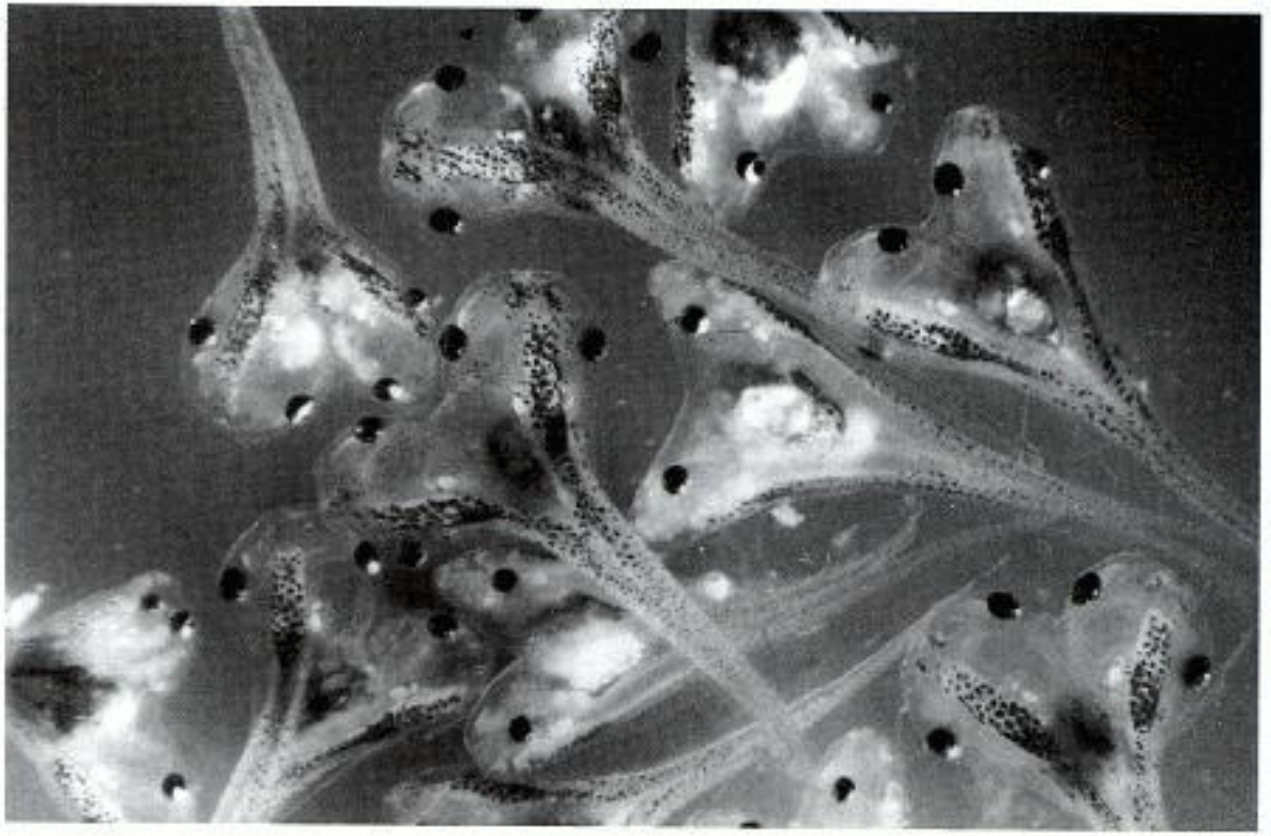


Vegetal Cell Transplatation

(A)



(B)



The Organizer

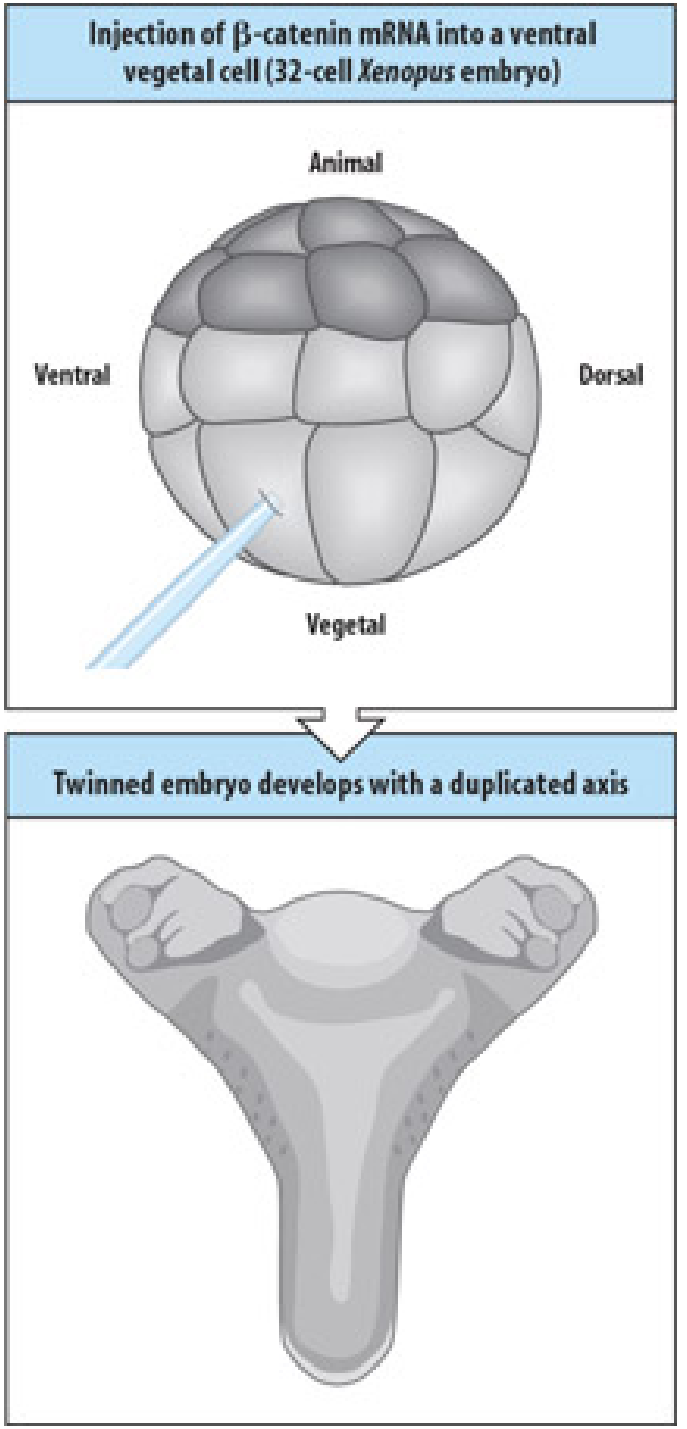
Diffusible factor found in dorsal lip cells

It itself is induced by underlying vegetal cells

Nieuwkoop center – beta catenin

- Functions as a transcription factor and cadherin binding protein

Beta catenin mRNA



Beta-catenin activity in Sea Urchins

Determines mesoderm

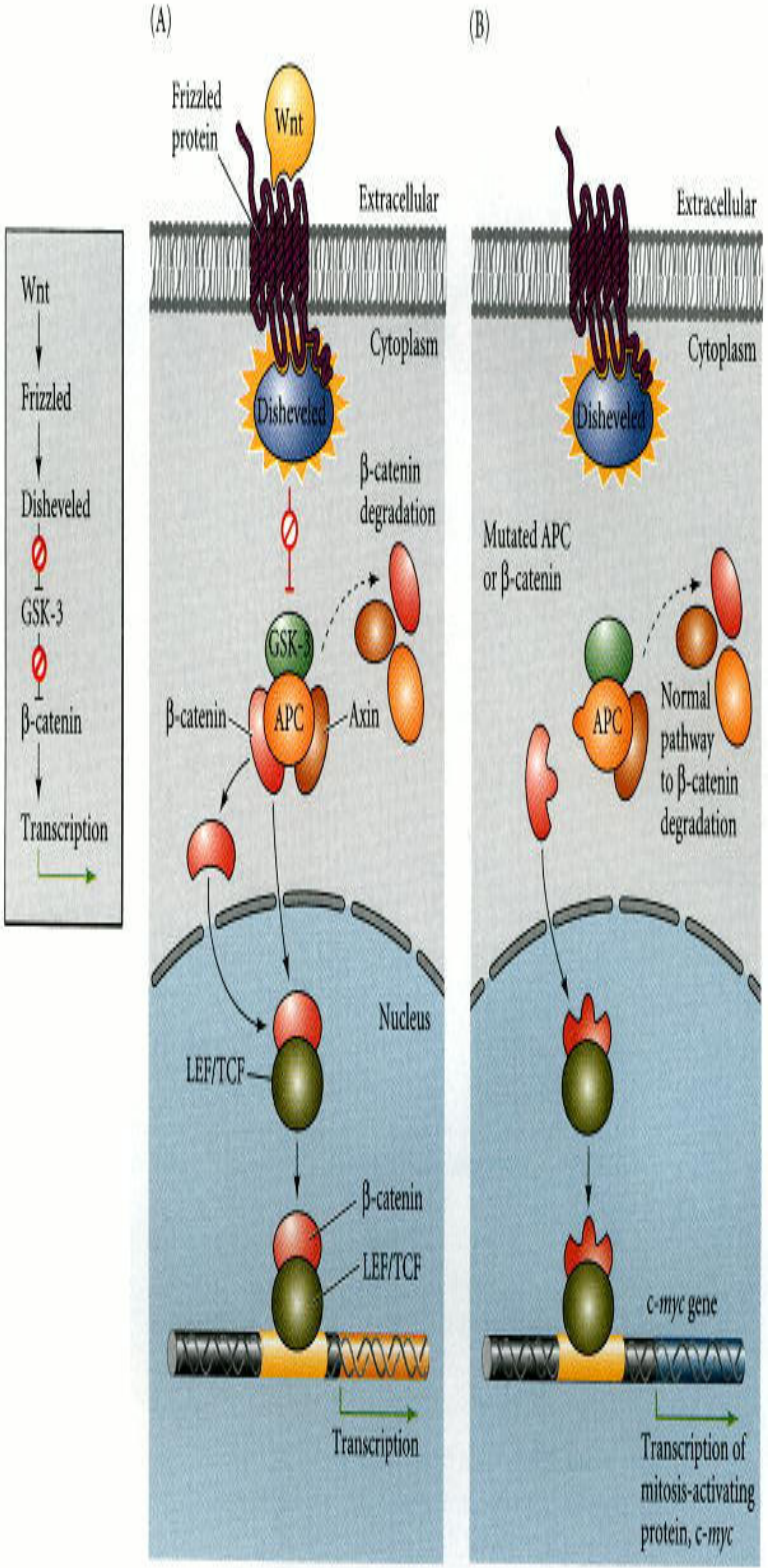
Found in micromeres and veg 2 layer

Found in nucleus when active

Beta-catenin controlled by Wnt

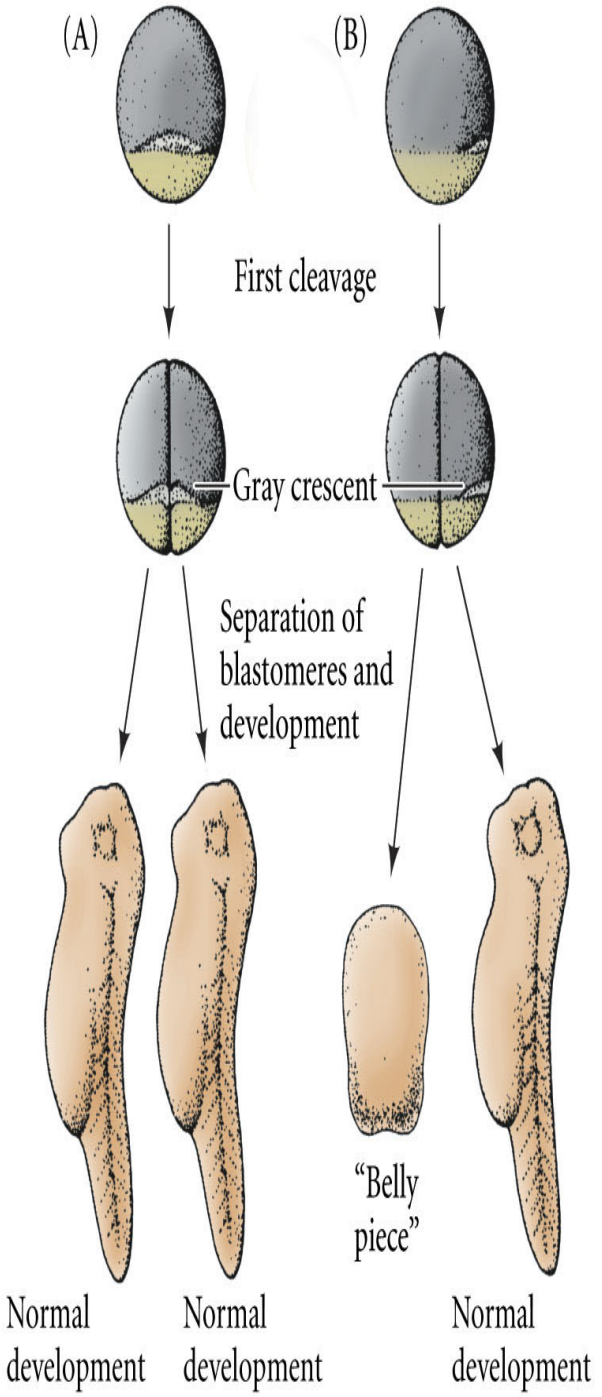
- Wnt turns on beta-catenin activity
  - Allows beta-catenin to enter nucleus and act like a transcription factor

Wnt Pathway


(A)
(B)
Frizzled protein
Wnt
Extracellular
Cytoplasm
Dishevelled
β-catenin degradation
GSK-3
APC
Axin
β-catenin
Nucleus
LEF/TCF
β-catenin
LEF/TCF
Transcription
Wnt
Frizzled
Dishevelled
GSK-3
β-catenin
Transcription
Mutated APC or β-catenin
Normal pathway to β-catenin degradation
c-myc gene
Transcription of mitosis-activating protein, c-myc

Spemann

- Blastomeres equivalent when they both have gray crescent.
- Gray crescent necessary for dorsal structures



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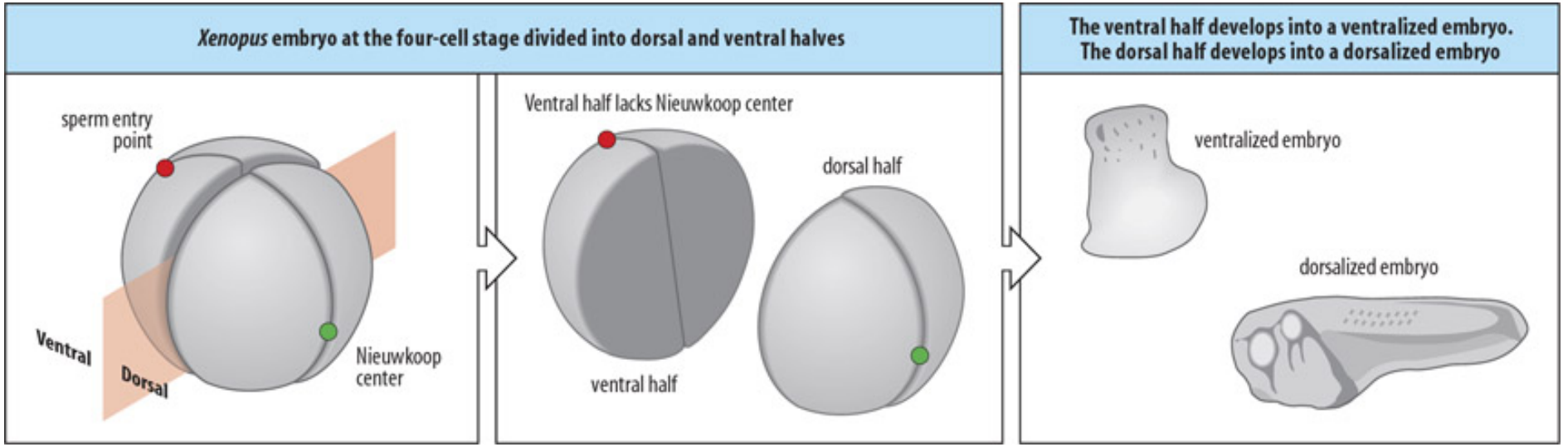
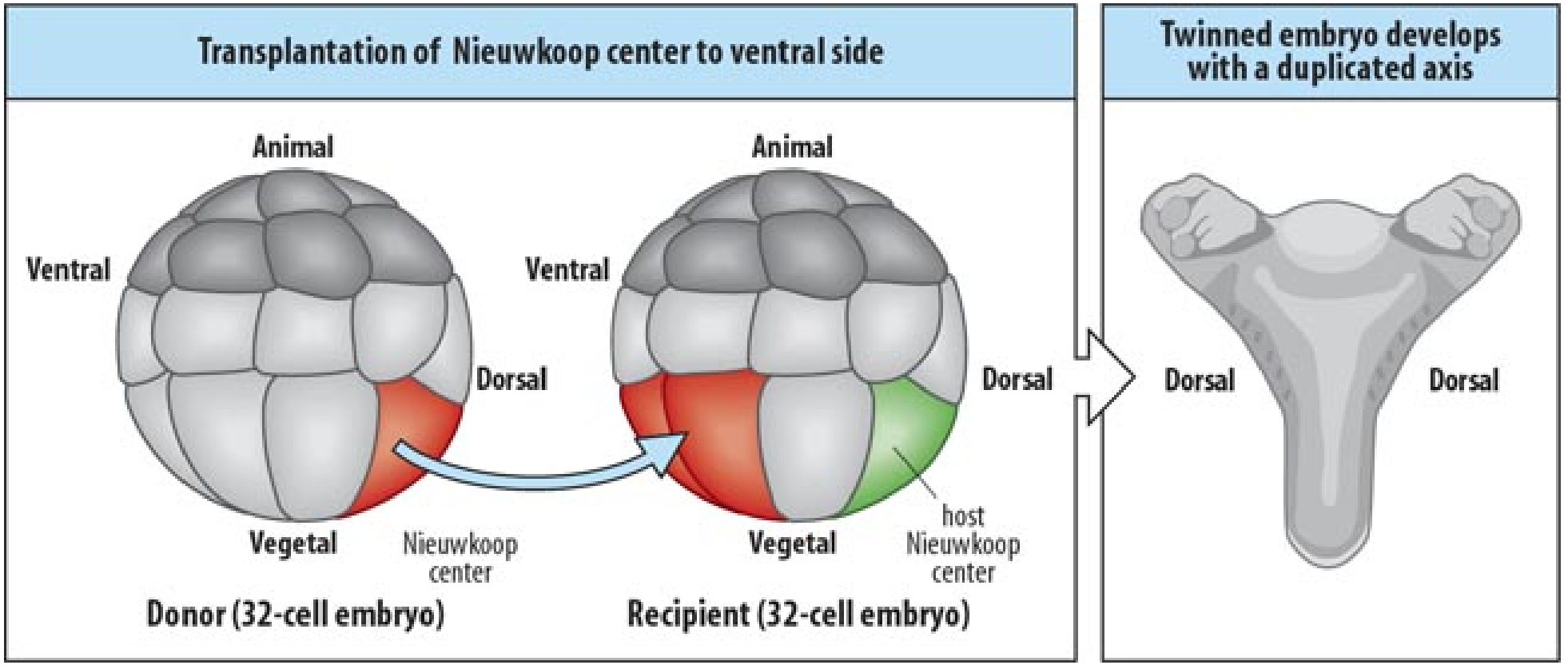
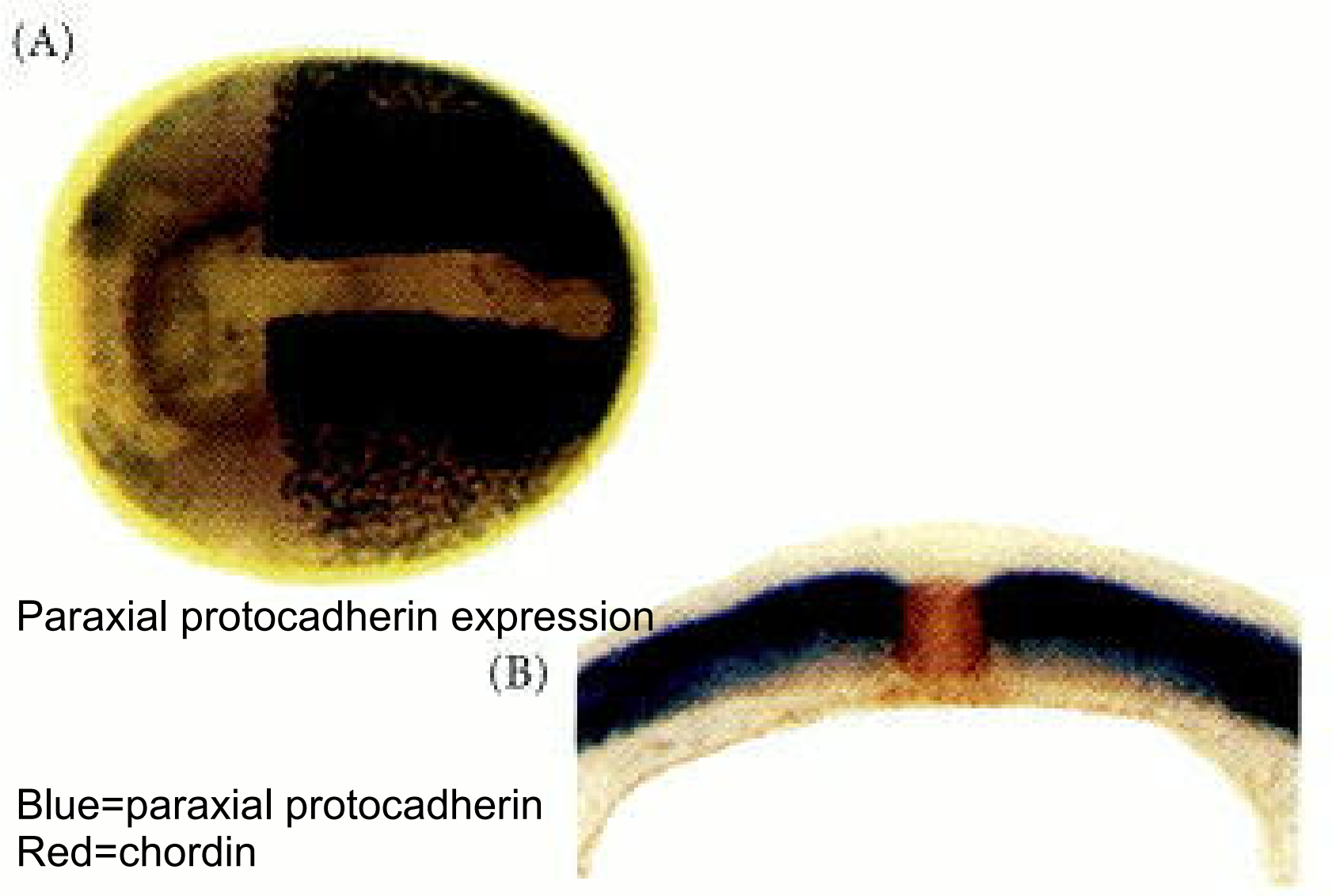
Nieuwkoop Center



Nieuwkoop Center Specifies Dorsal Side



Expression of paraxial protocadherin



Paraxial protocadherin expression

Blue=paraxial protocadherin
Red=chordin

Beta-catenin localization

How does beta-catenin become localized to dorsal side?

Beta-catenin evenly distributed before fertilization.

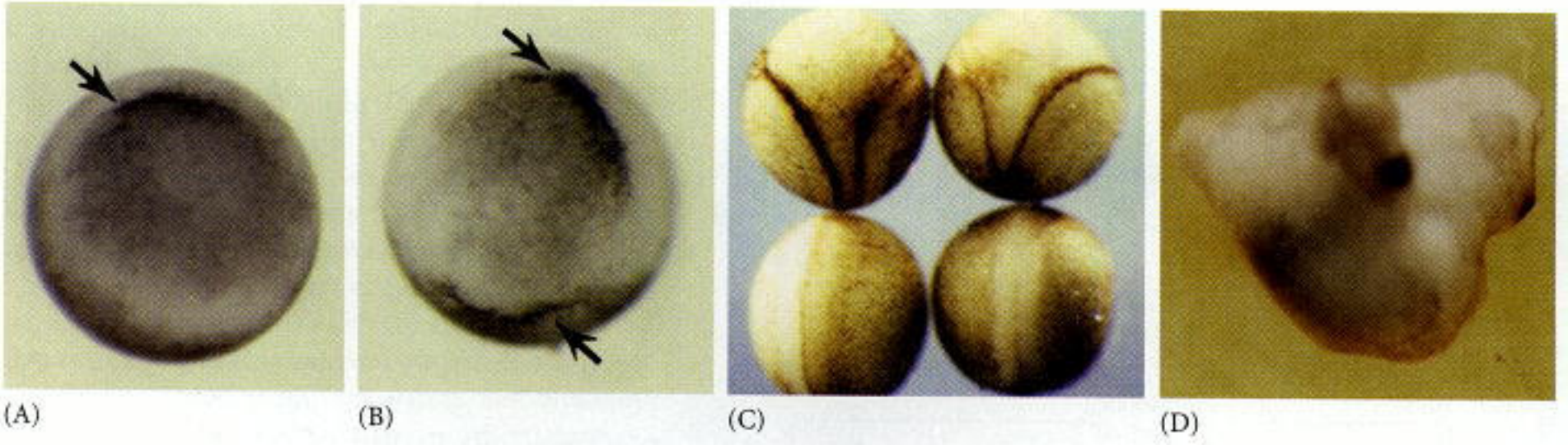
Dsh and GBP translocated to dorsal side by kinesin

- Rides on microtubule tracks laid down after fertilization during cortical rotation
- Dorsal surface enriched in Dsh and GBP
- Dsh and GBP inhibit GSK3
  - Beta-catenin degrades on ventral side and is stabilized on dorsal side

Beta-catenin activates other genes

Turns on goosecoid gene in organizer

Goosecoid mRNA can induce new axis



- Activates involution
- Determines dorsal mesoderm
- Represses Wnt8
- Important in brain formation

VegT and Veg1

Present in vegetal cortical region

Genes required for endoderm and mesoderm formation

VegT antisence RNA causes epidermis only

Xnr Gradient

High Xnr – Organizer, goosecoid

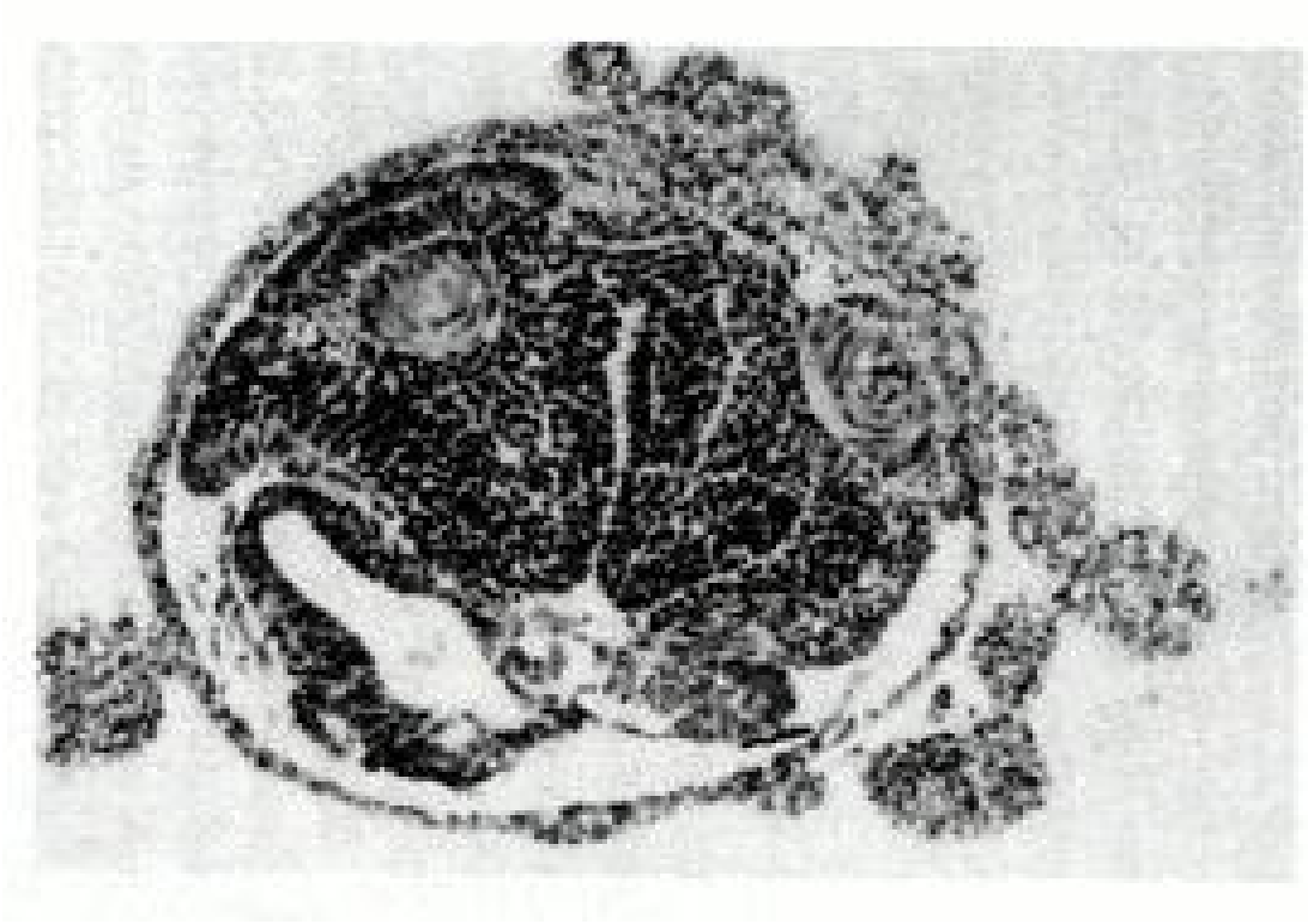
Med Xnr – Lateral mesoderm

Low Xnr > high BMP4 + Xwnt8 – Ventral mesoderm

Neural ectoderm induced by soluble factor?

Controlled by goosecoid and beta-catenin?

Induction of ectopic neural structures



Neural structures **default** – epidermis induced by BMP's

BMP – bone morphogenic protein

- Induce ectoderm to become epidermis
- Organizer secretes factors that block BMP from acting

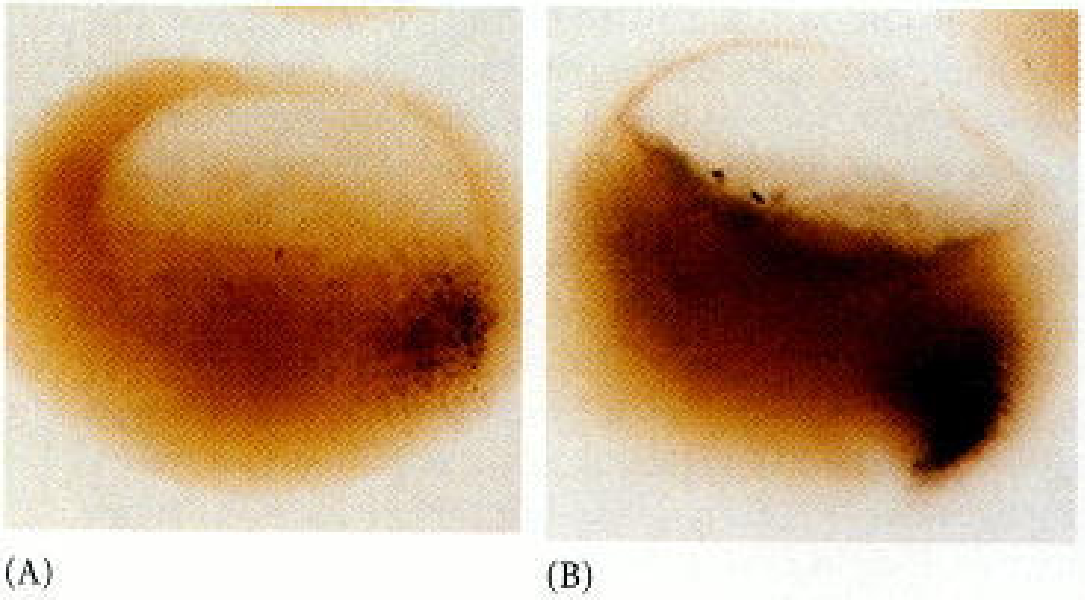
BMP inhibitors

Noggin, Chordin and Follistatin

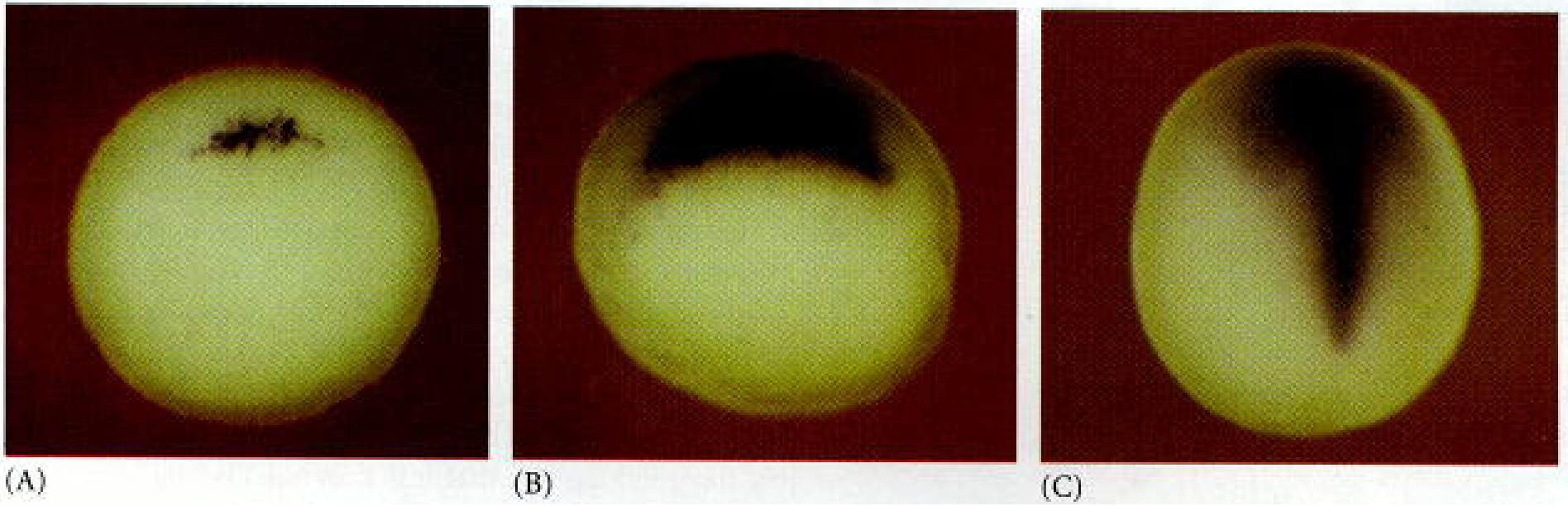
- Diffusable proteins
- Induced dorsal ectoderm to become neural
- Dorsalizes mesoderm cells
- Inhibits BMP's
- Found in dorsal lip then in the notochord

Noggin mRNA rescues Dorsal Structures

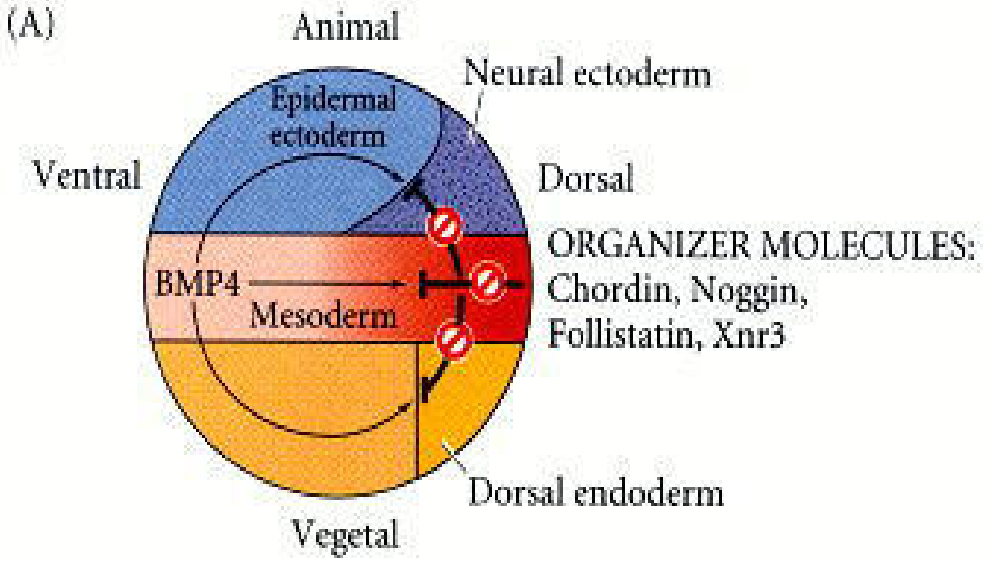
Localization of Noggin

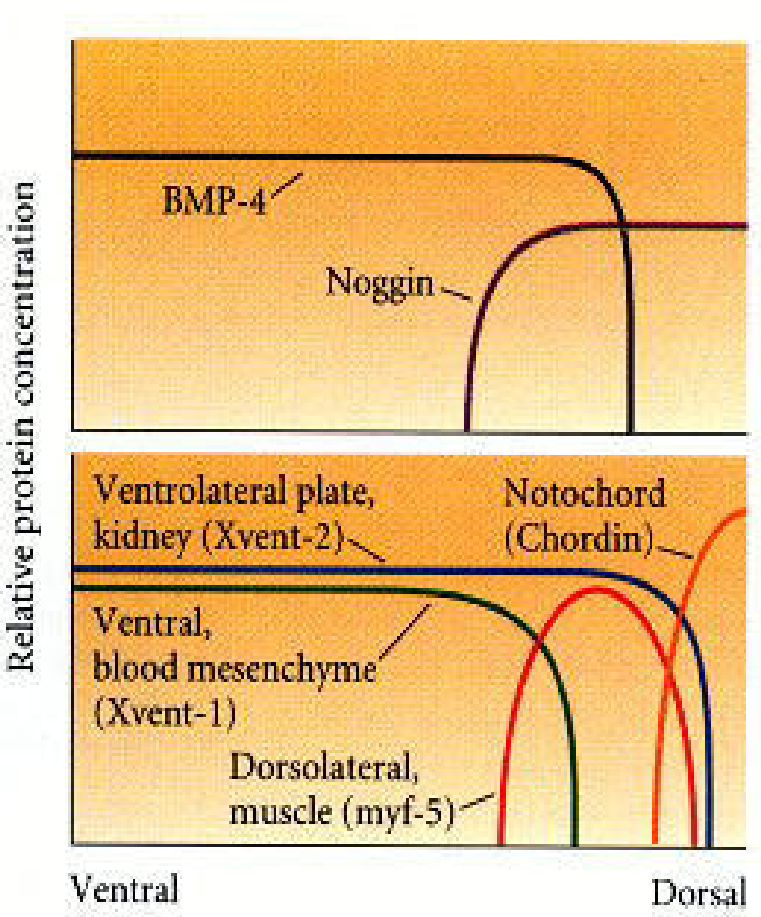


Localization of Chordin mRNA



BMP Gradient Controls Dorsal/Ventral Axis





How is the ant/pos axis determined?

During neurulation beta-catenin forms a gradient

Greatest concentration at organizer

- Becomes anterior end

Wnt Gradient Controls Anterior/Posterior Axis