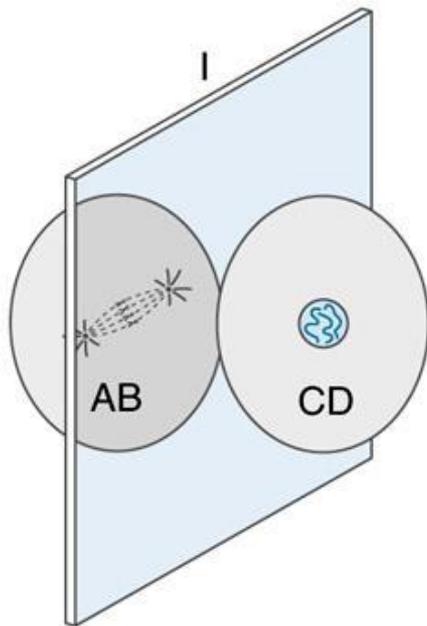
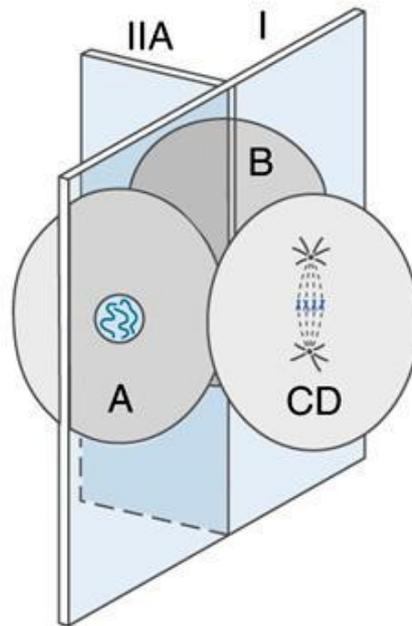


# Gastrulación

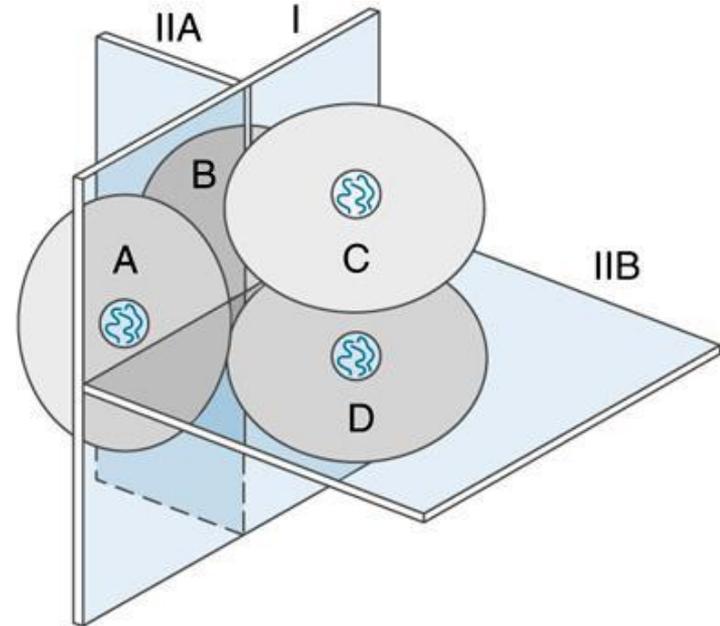
## Embriones con clivaje holoblástico: mamíferos



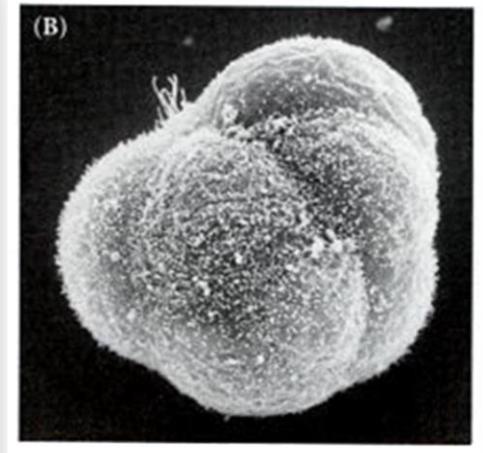
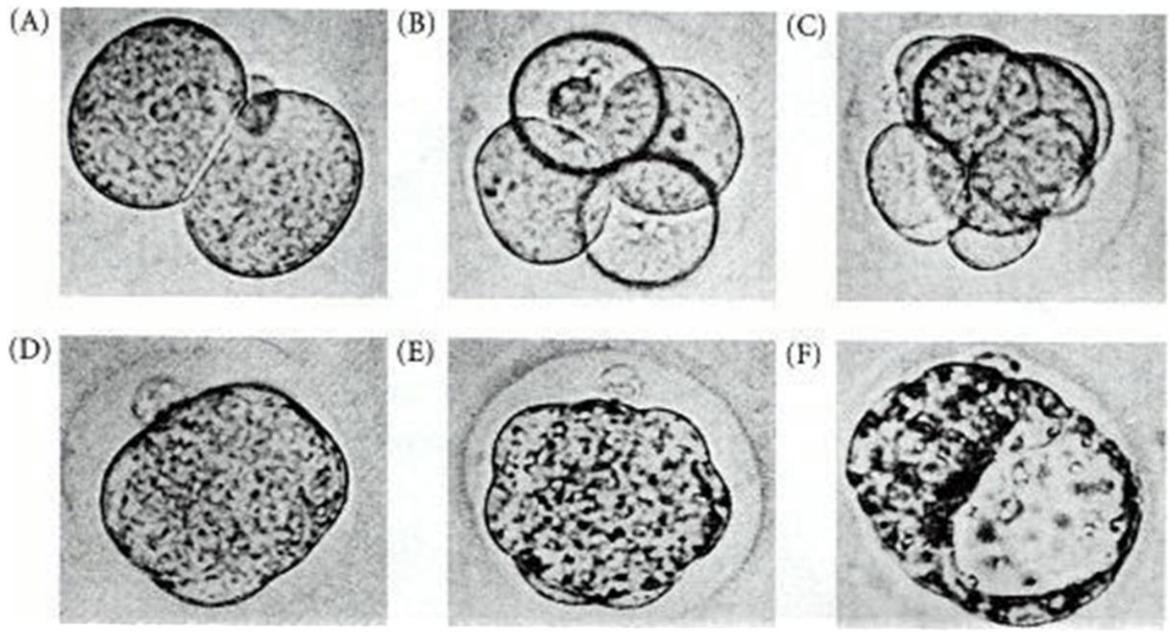
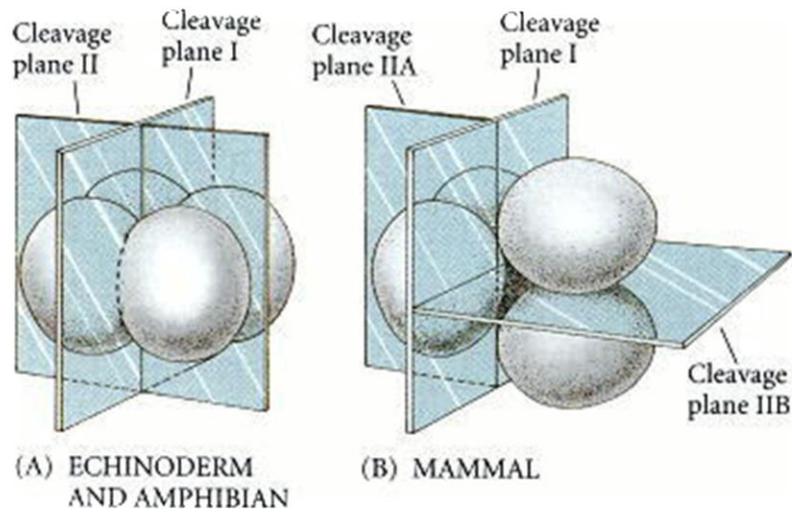
(a)



(b)

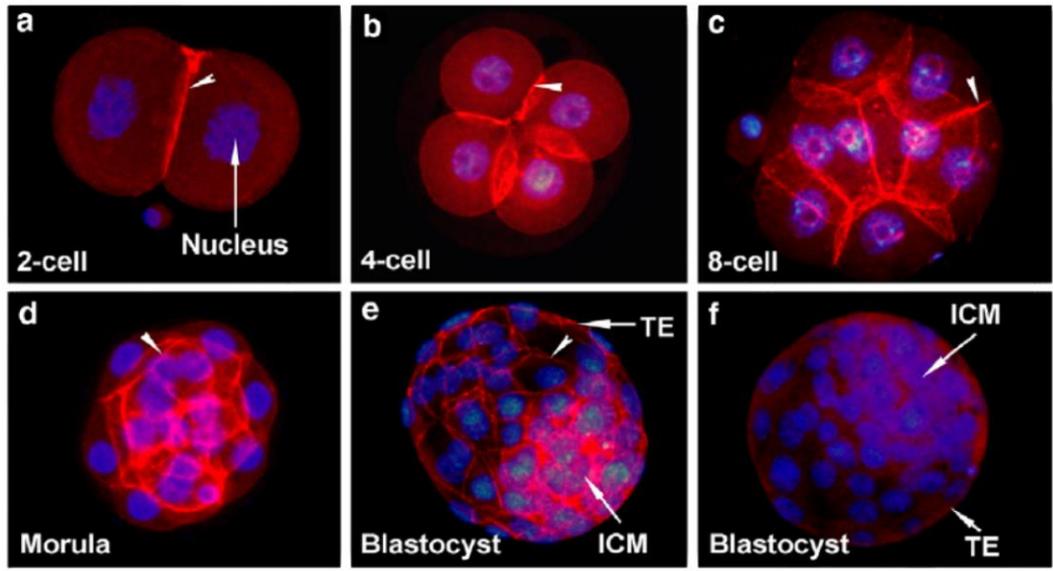


(c)

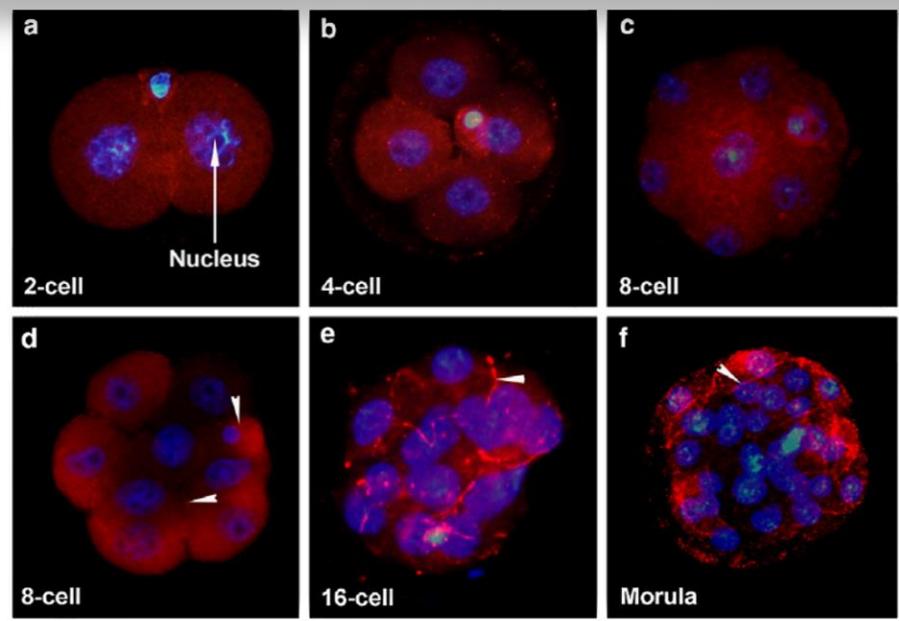


12-24 horas cada ciclo!

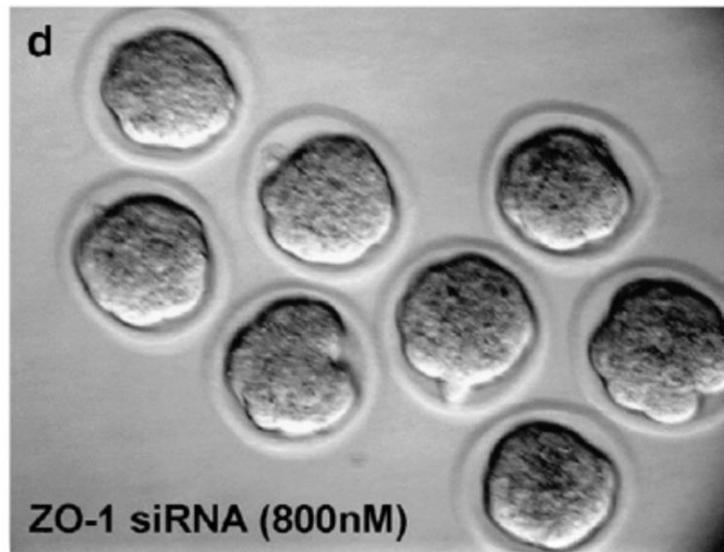
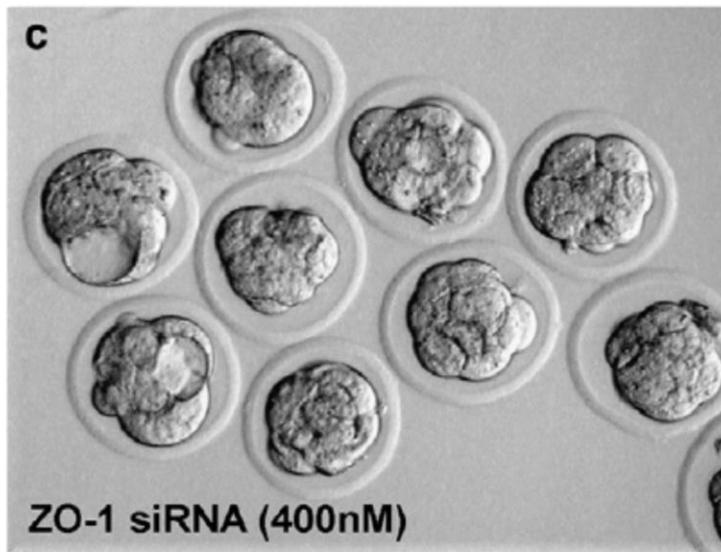
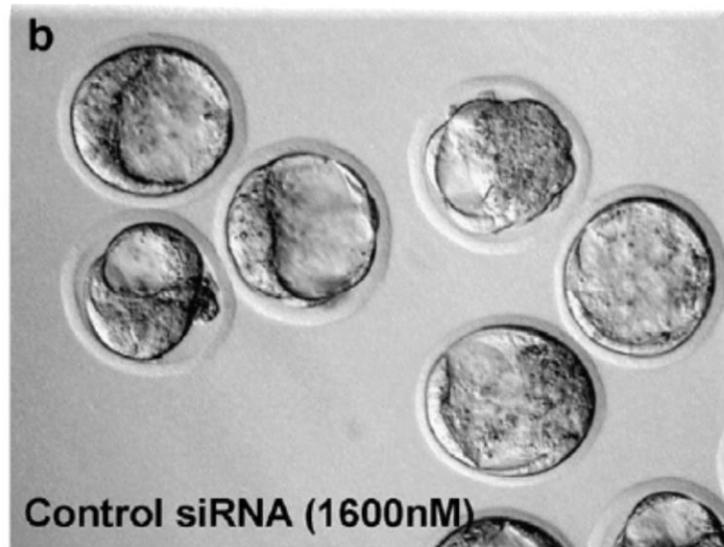
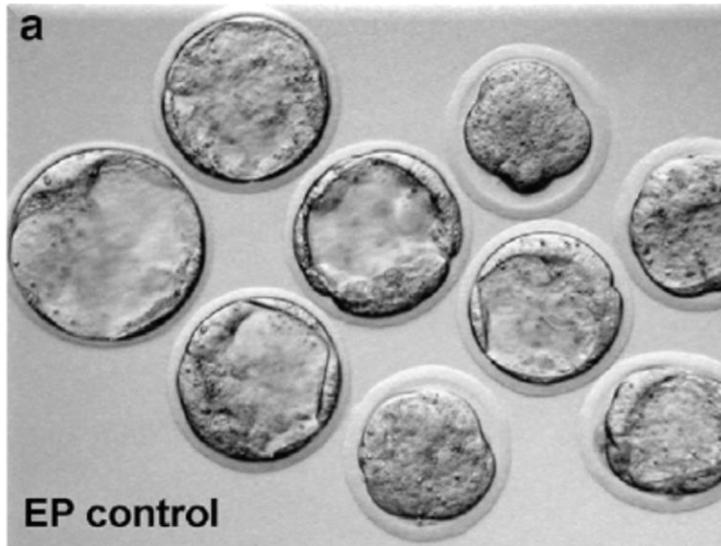
# Compactación: polaridad celular y uniones celulares



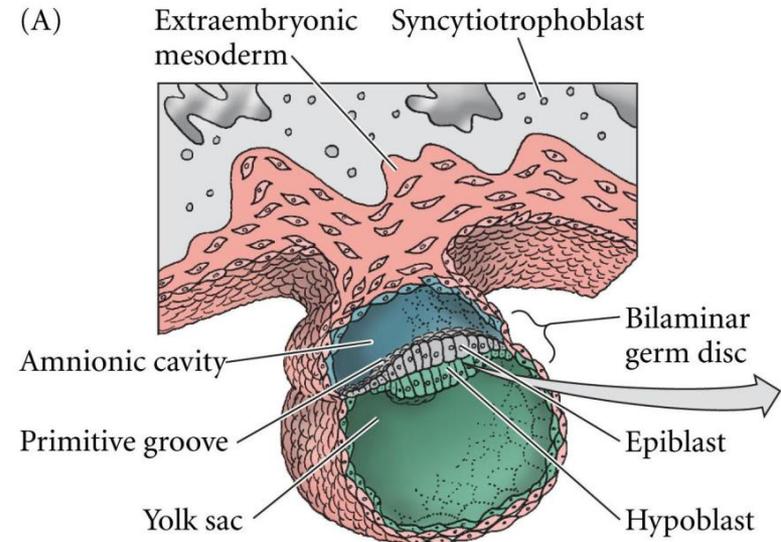
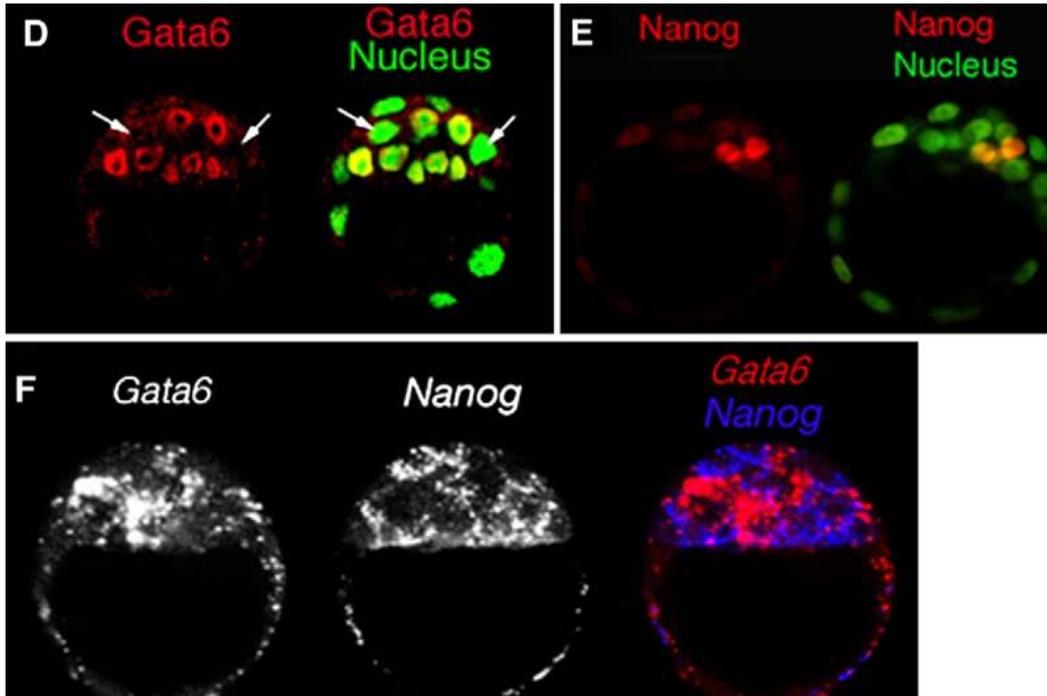
E-Cadherina



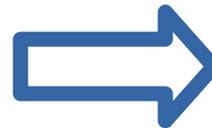
ZO-1



# El endodermo primitivo: hipoblasto de mamíferos

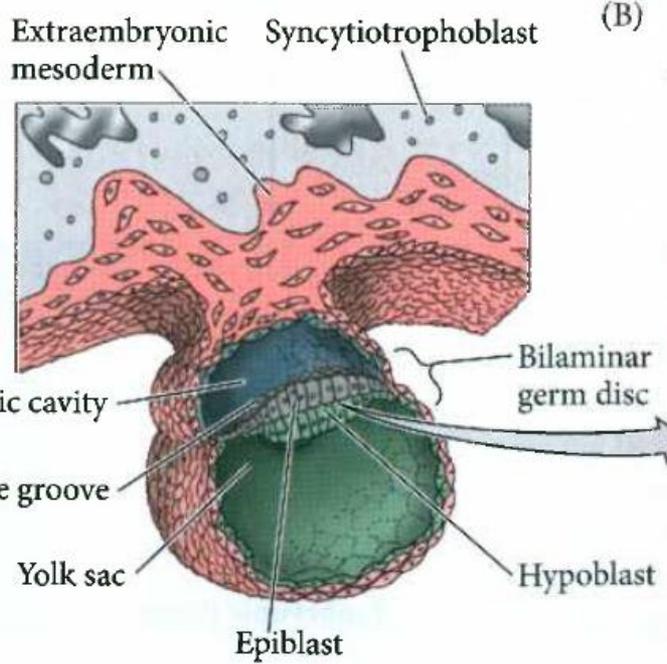


**Gata6** endodermo primitivo  
**Nanog** epiblasto

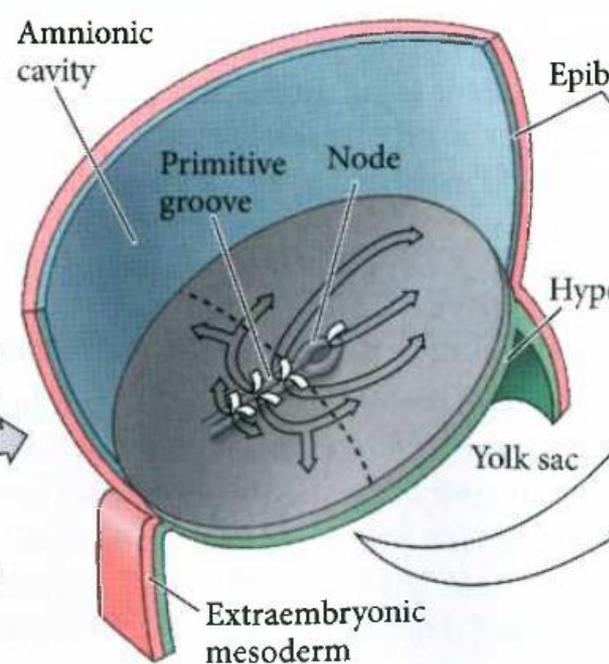


Disco bilaminar germinal

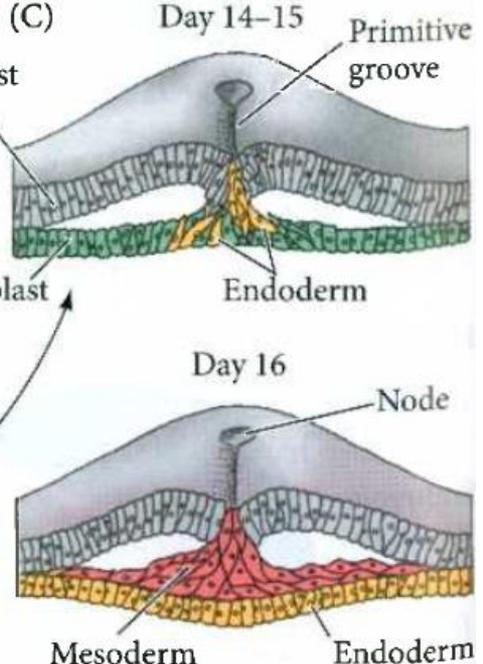
(A)

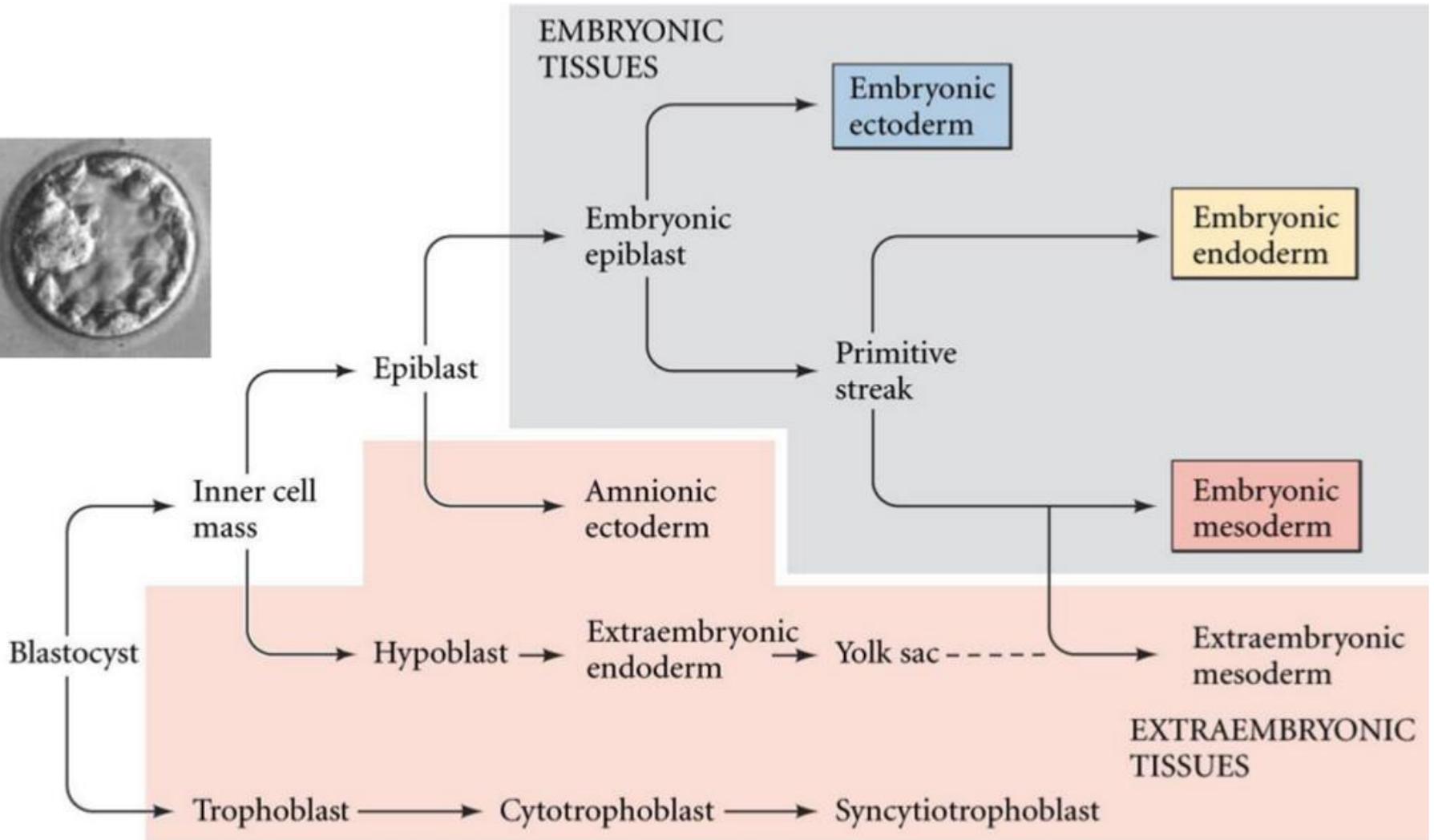


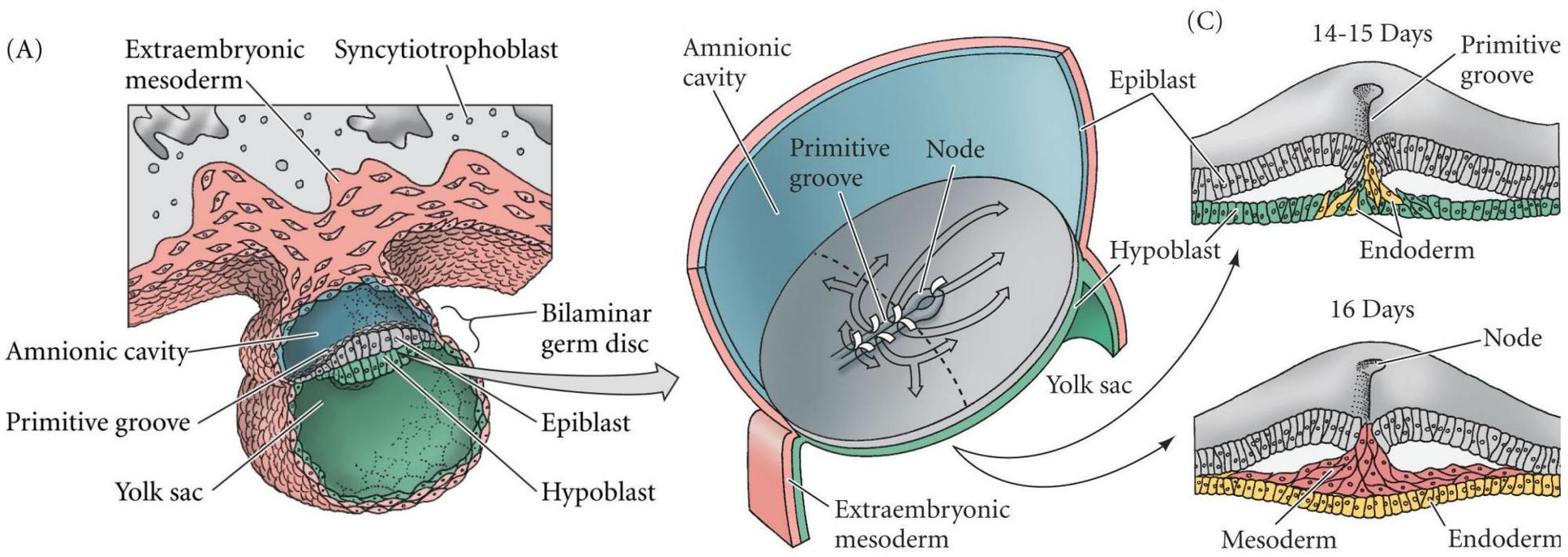
(B)



(C)







# Desarrollo temprano en metazoarios III



<https://www.youtube.com/watch?v=EPx-OUXIAIE>

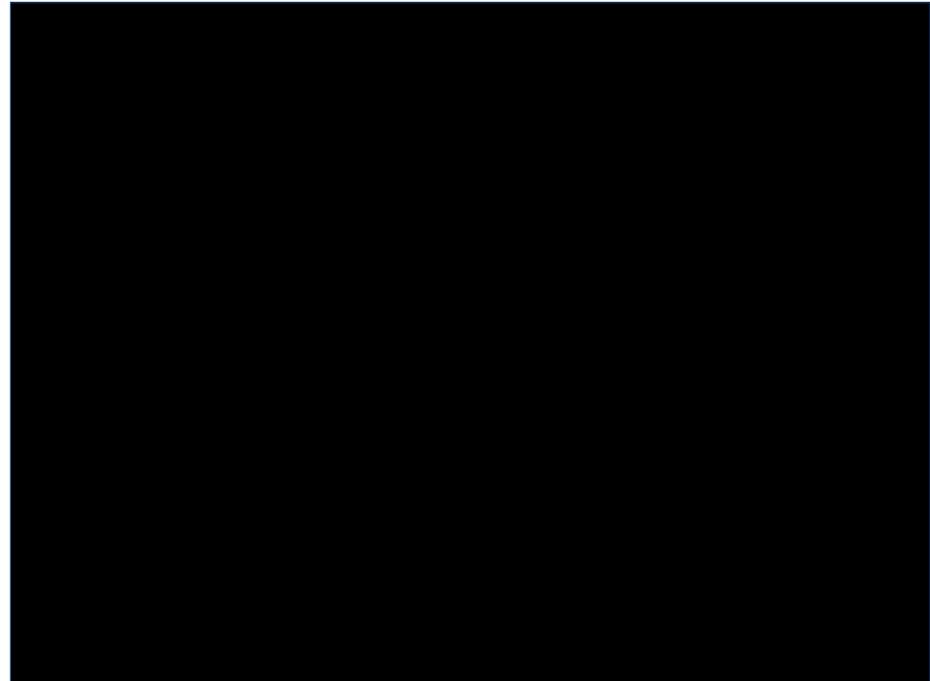
**Gonzalo Aparicio**

# Neurulación: cierre del tubo neural



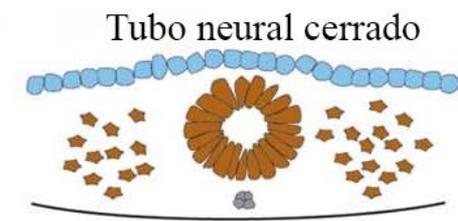
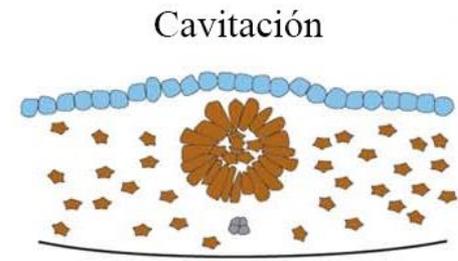
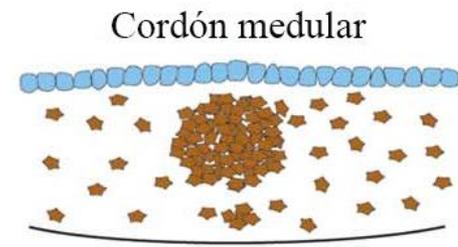
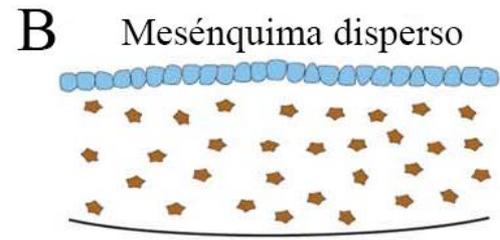
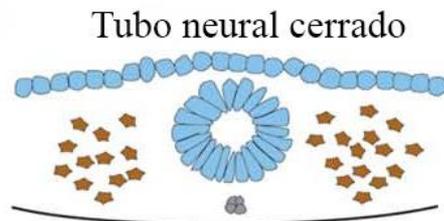
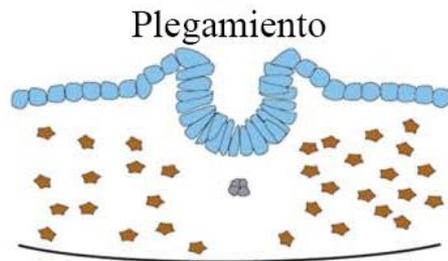
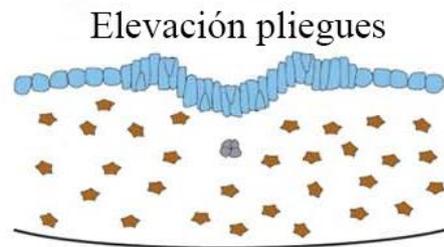
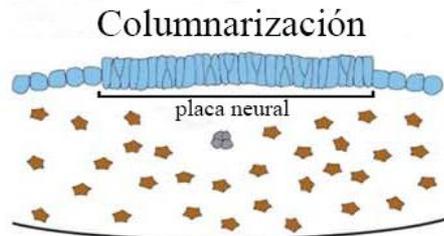
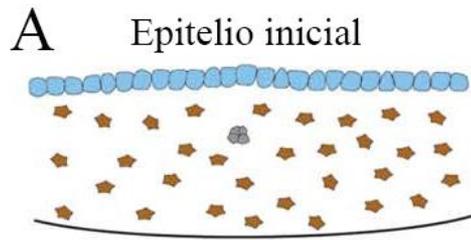
Anfibios

<https://www.youtube.com/watch?v=qisrNX3QjUg>

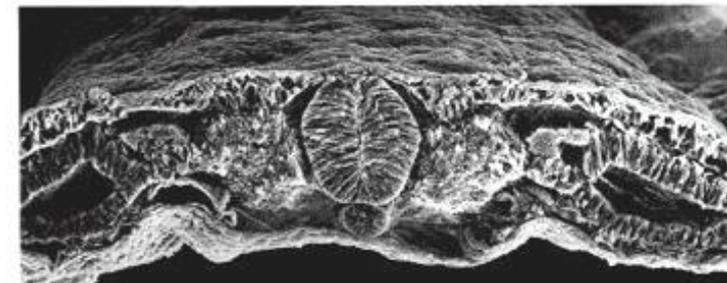
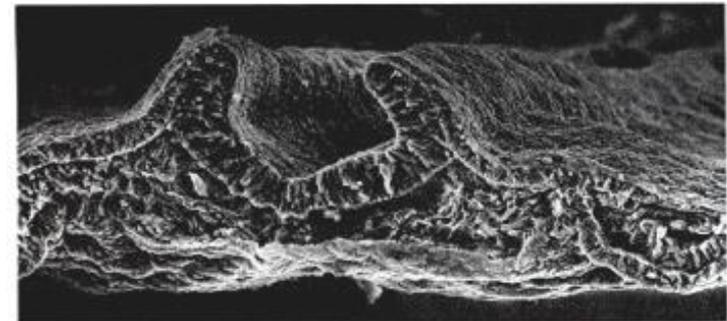
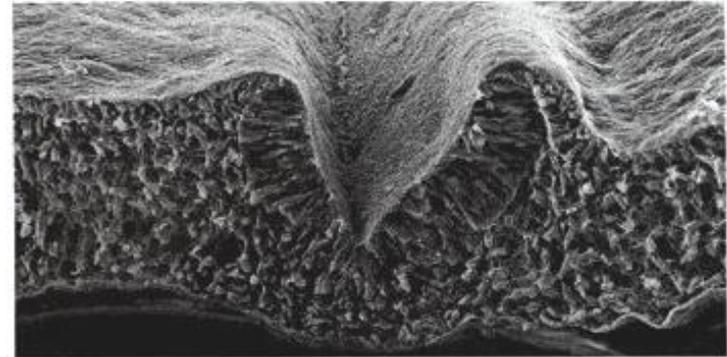


Aves

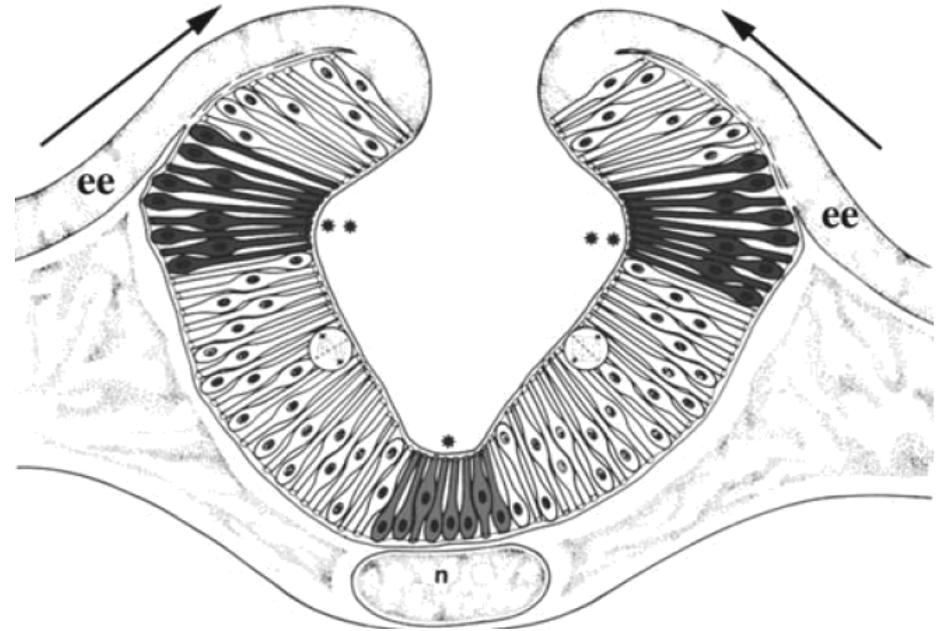
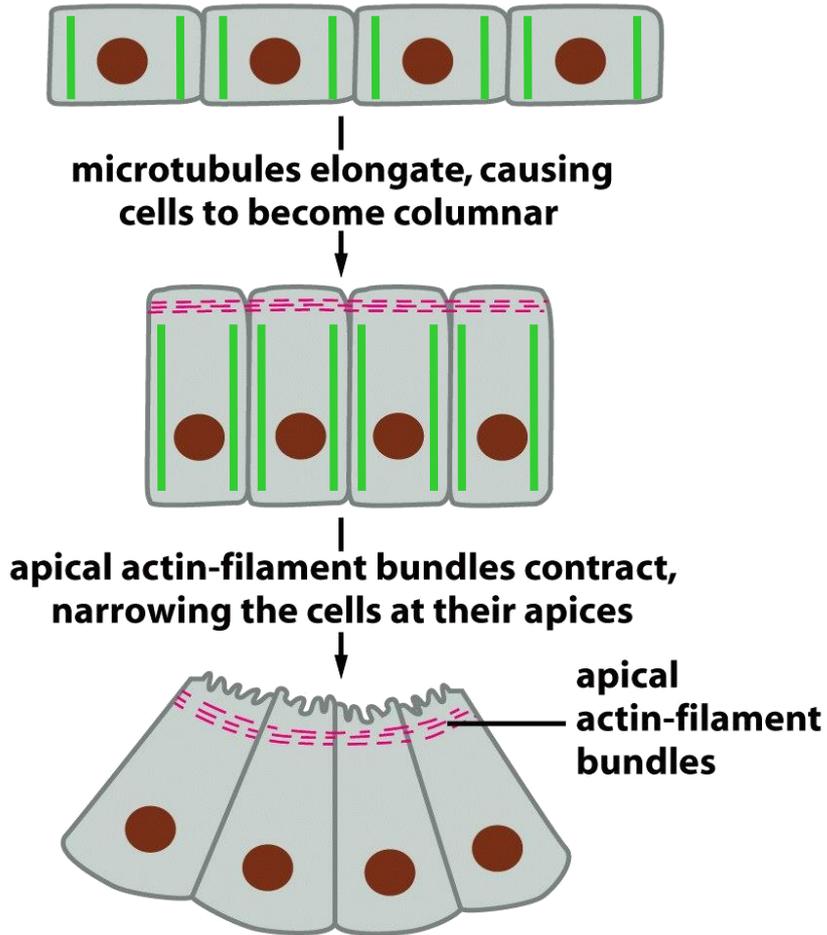
<https://www.youtube.com/watch?v=u52pTXtg75s>



# Cierre del tubo neural: Neurulación primaria

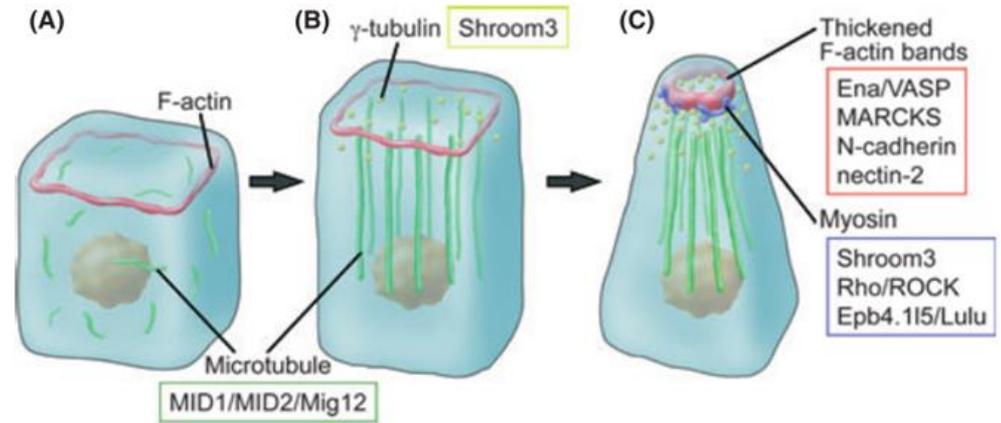


# Fuerzas intrínsecas/extrínsecas a la placa neural

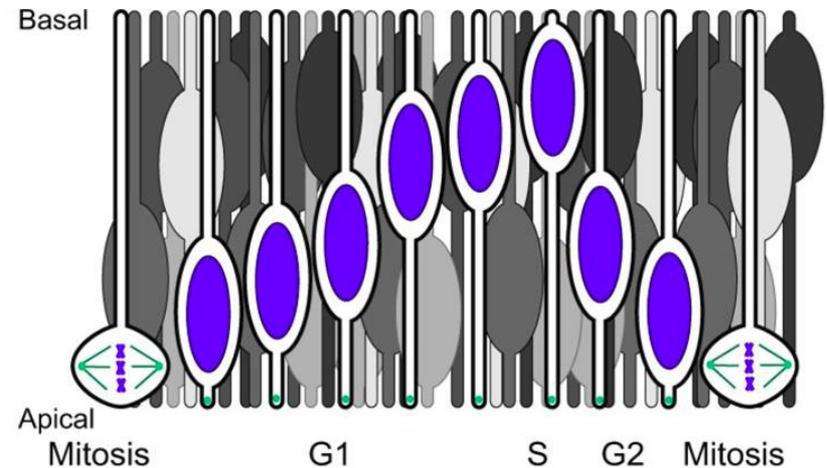


# Formación de puntos de bisagra

Constricción apical

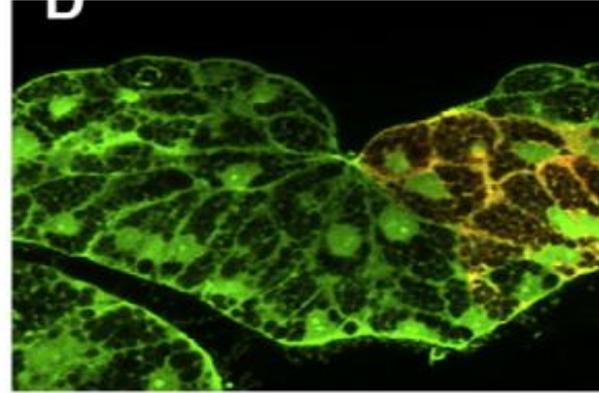
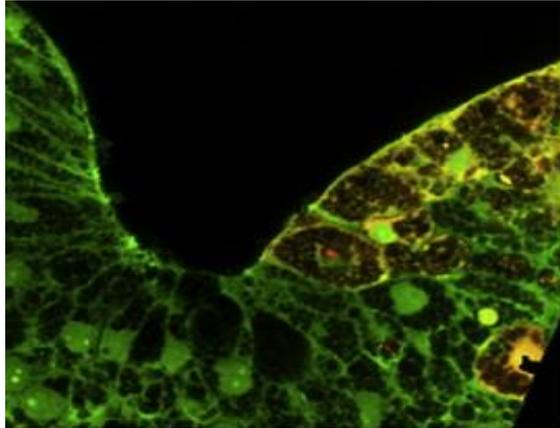


Ensanchamiento basal



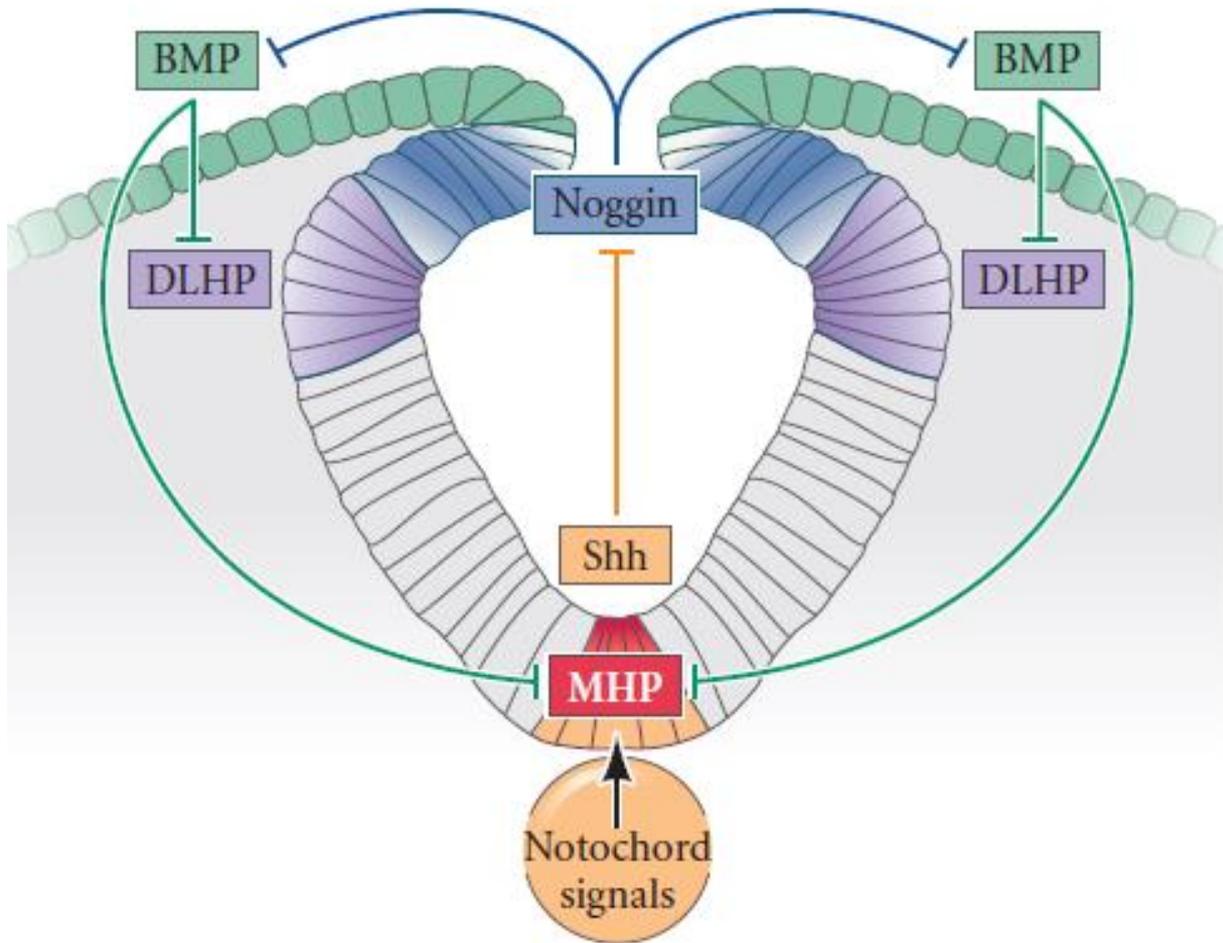
Migración nuclear intercinética

# Cierre del tubo neural: movimientos celulares y citoesqueleto de actina

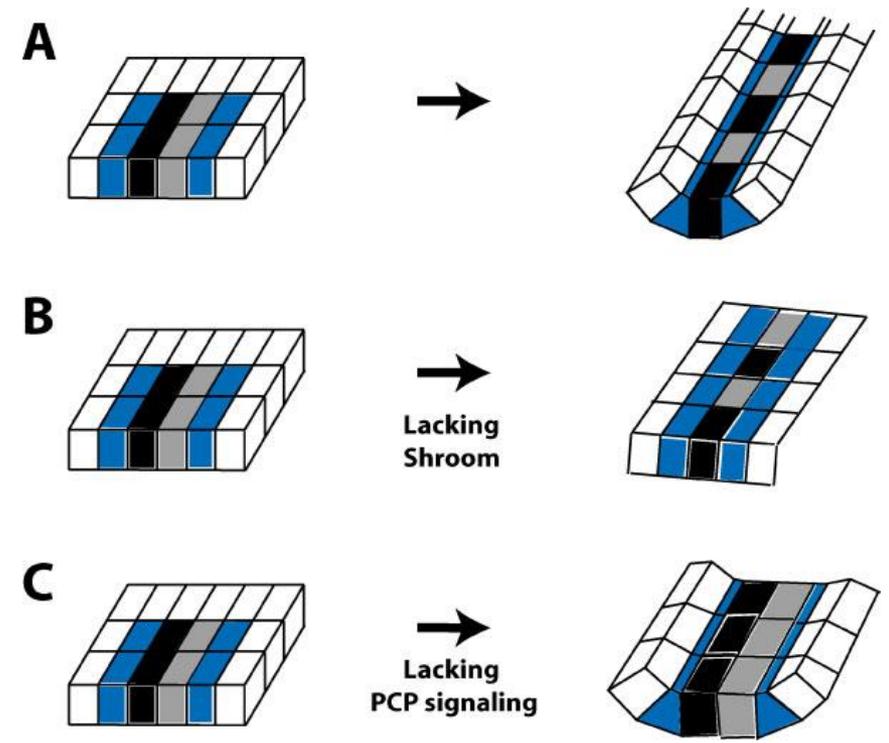
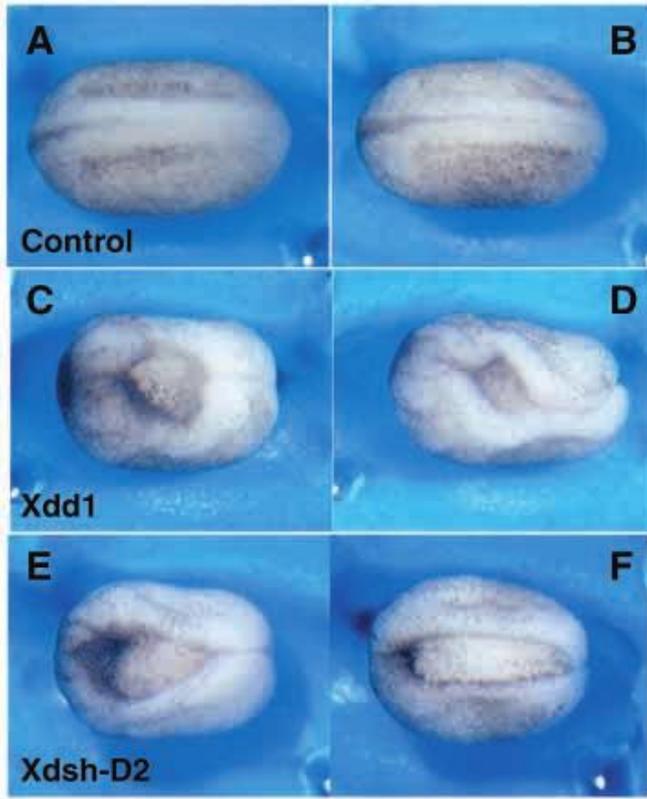
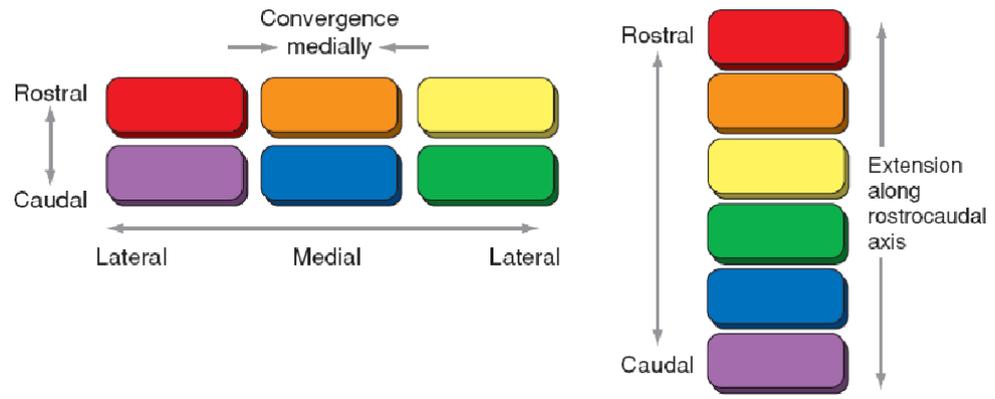






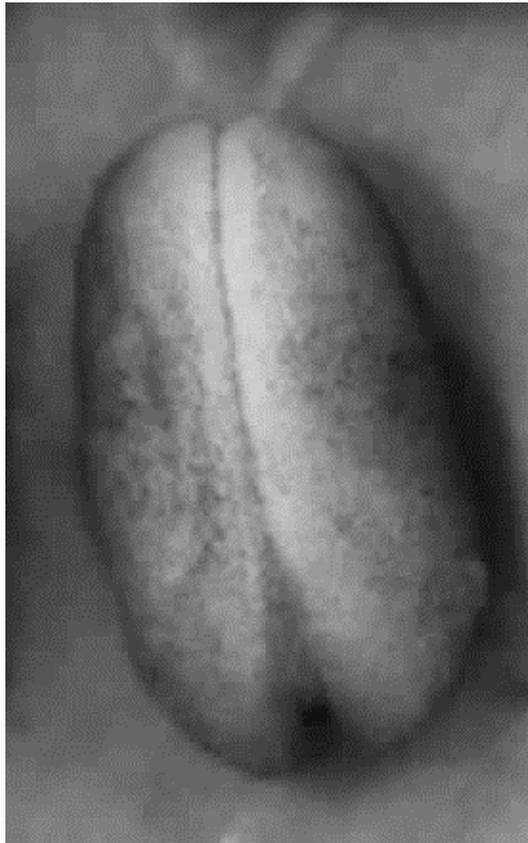


# Cierre del tubo neural: extensión-convergencia y polaridad planar

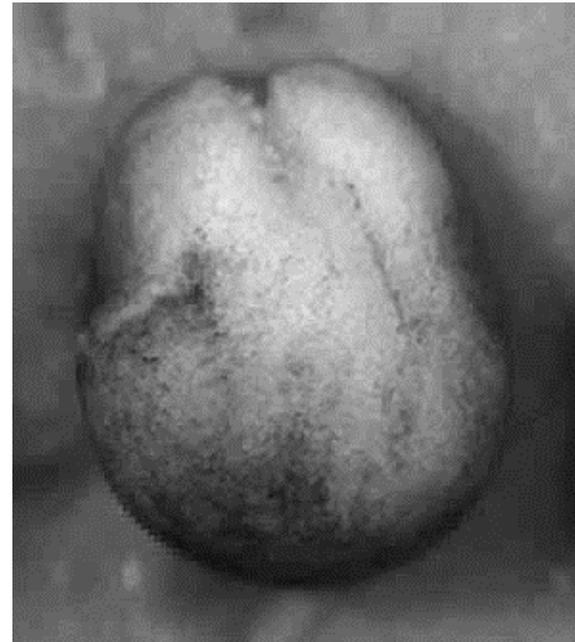


## Neural tube closure requires Dishevelled-dependent convergent extension of the midline

John B. Wallingford\* and Richard M. Harland



Control



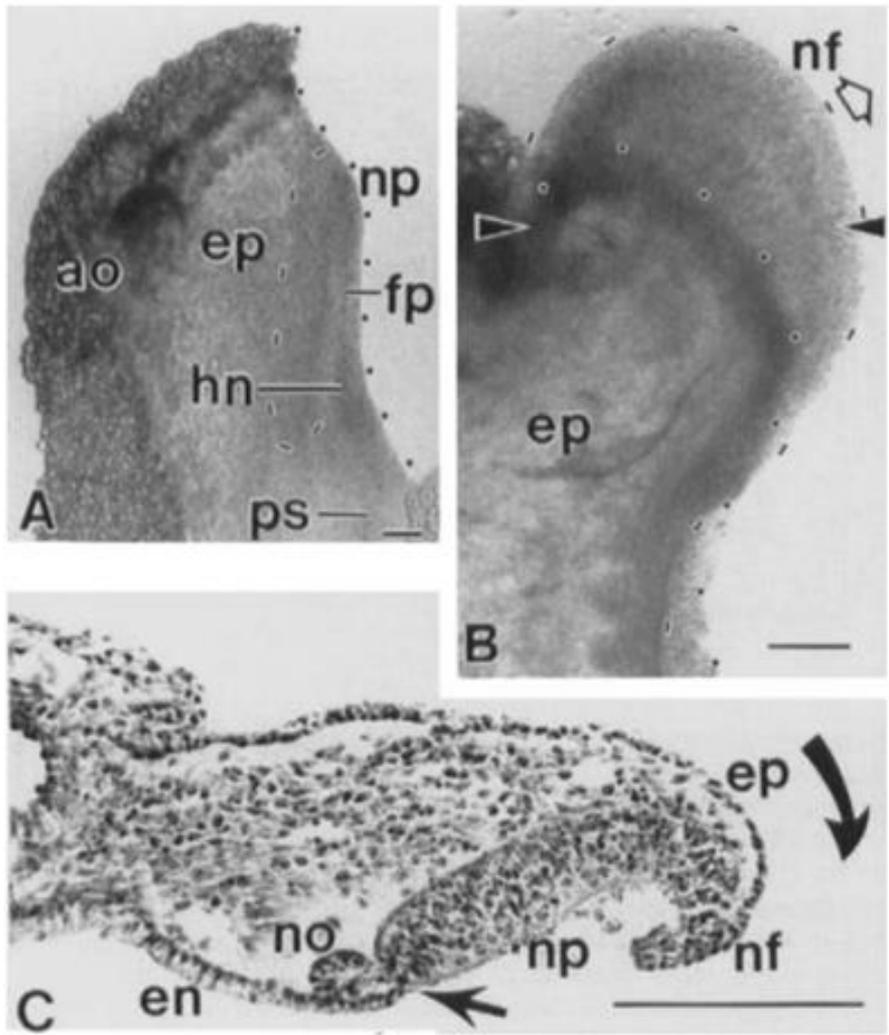
MO Xdsh

<https://youtu.be/MzHVHLHnMN0>

<https://youtu.be/9edjA6jV7Ho>

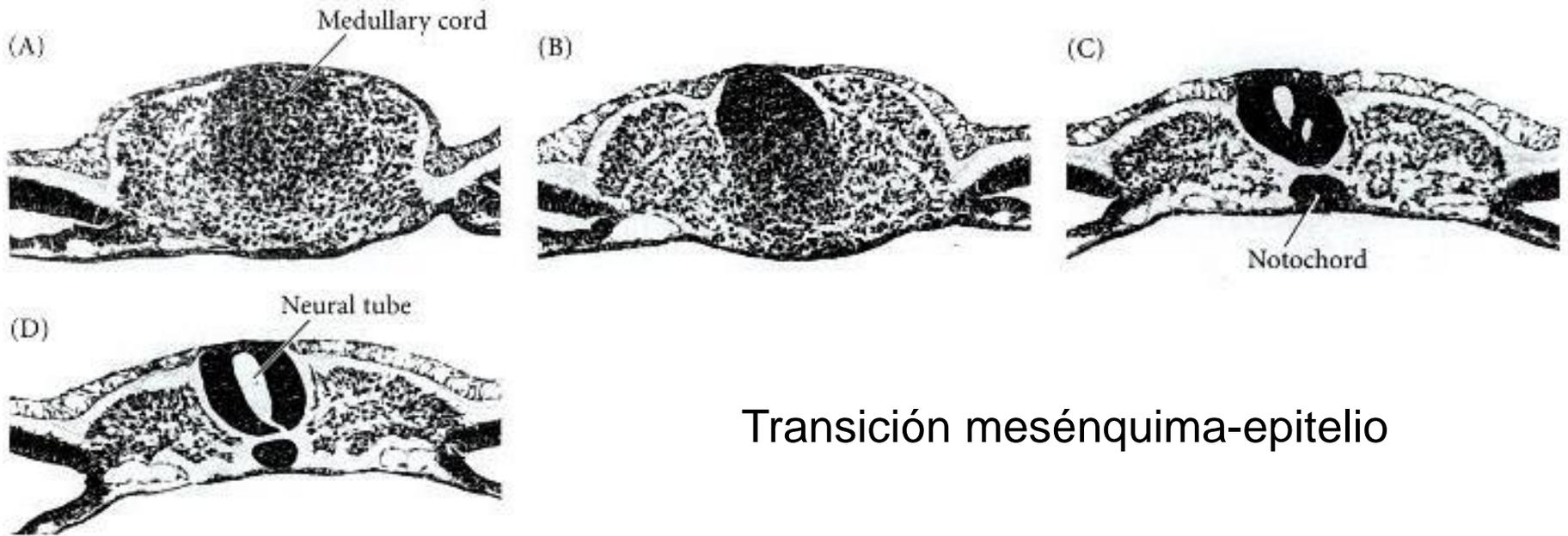
# Cooperative Model of Epithelial Shaping and Bending During Avian Neurulation: Autonomous Movements of the Neural Plate, Autonomous Movements of the Epidermis, and Interactions in the Neural Plate/Epidermis Transition Zone

J. DAVID MOURY AND GARY C. SCHOENWOLF



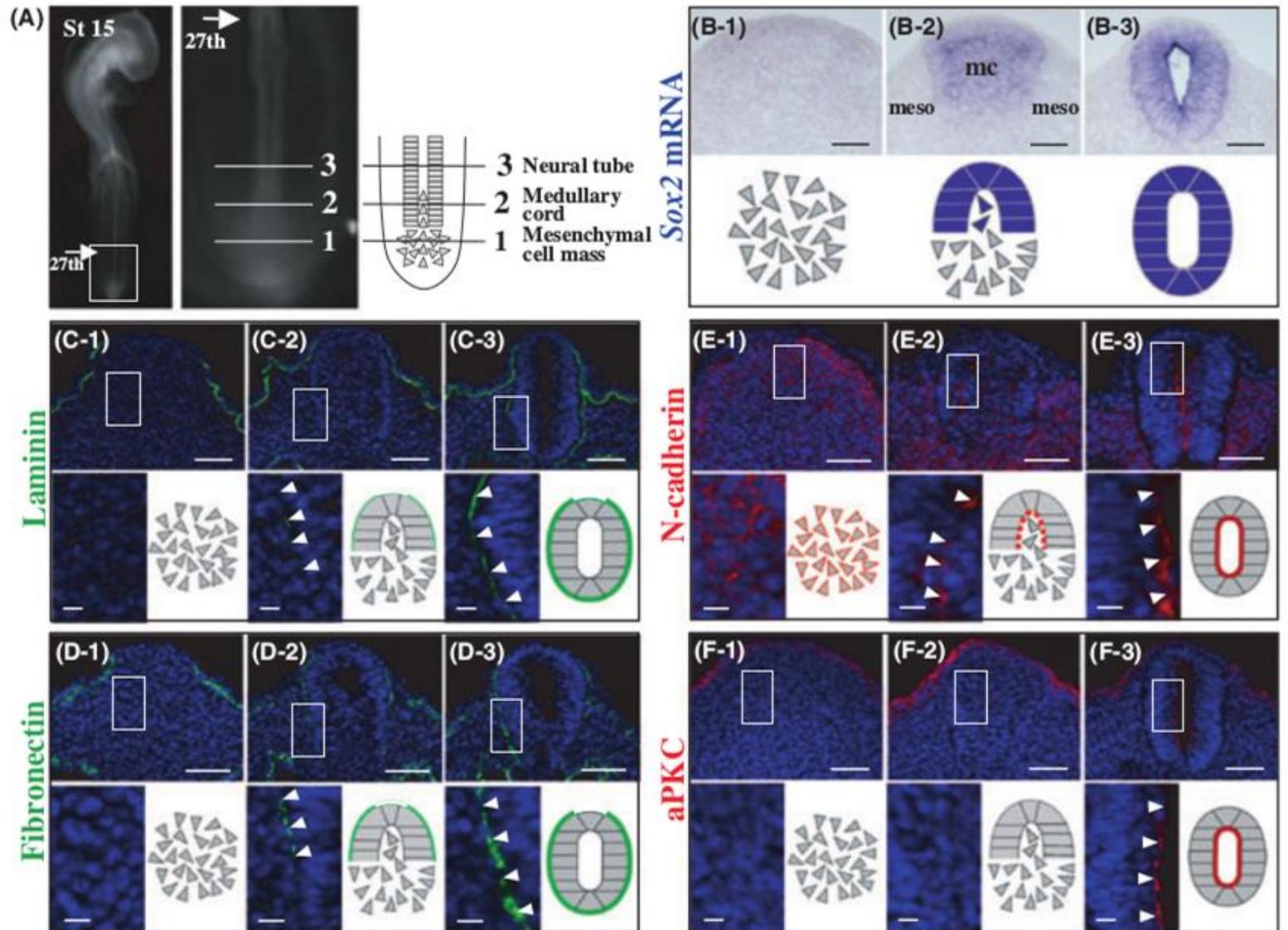
Fuerzas extrínsecas:  
ectodermo no neural

# Cierre del tubo neural: Neurulación secundaria



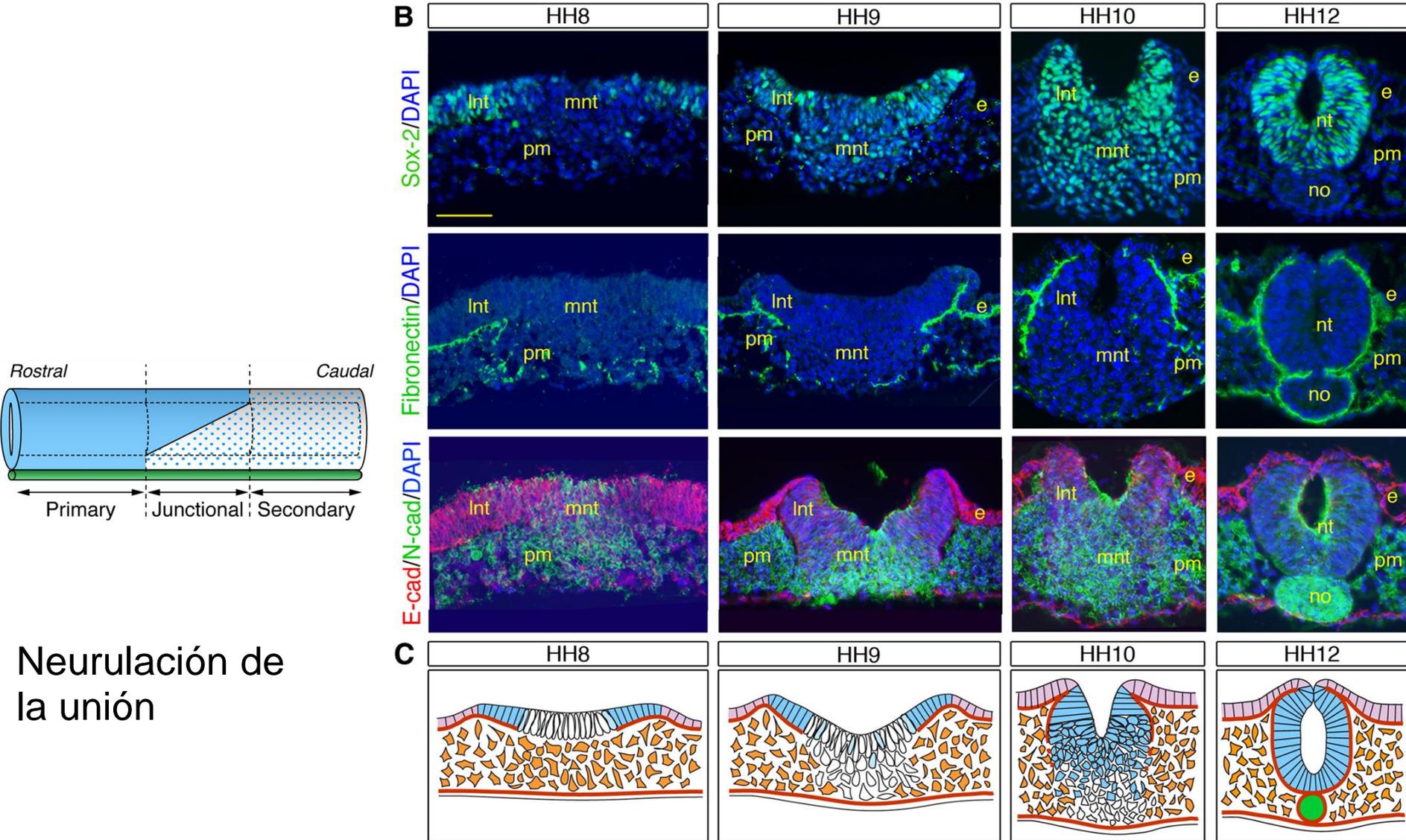
Transición mesénquima-epitelio

# Adquisición de polaridad epitelial



# Junctional Neurulation: A Unique Developmental Program Shaping a Discrete Region of the Spinal Cord Highly Susceptible to Neural Tube Defects

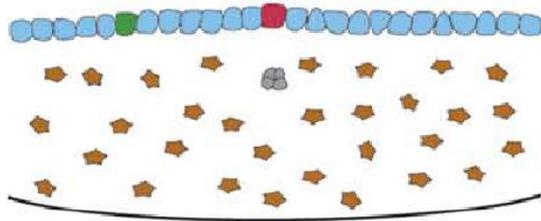
Alwyn Dady,<sup>1,2</sup> Emmanuelle Havis,<sup>1,2</sup> Virginie Escriou,<sup>3</sup> Martin Catala,<sup>1,2,4</sup> and Jean-Loup Duband<sup>1,2</sup>



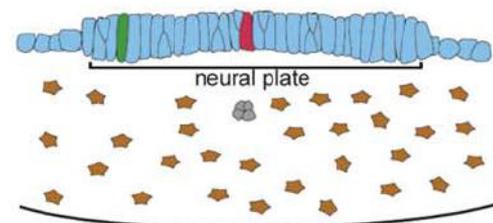
Neurulación de la unión

# Neurulación en peces

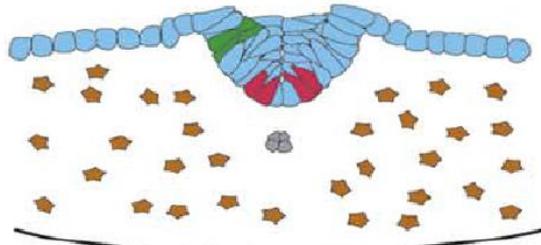
1. Initial epithelium



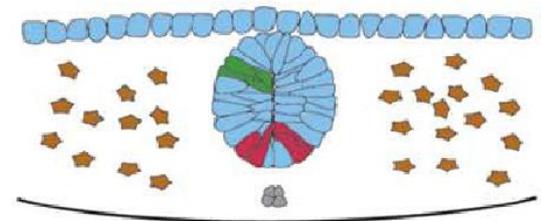
2. Columnarization



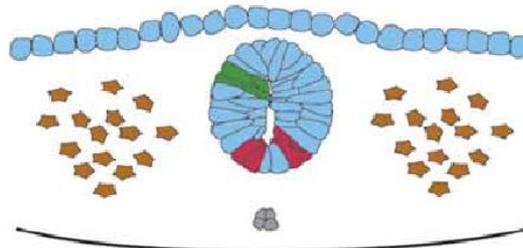
3. Neural keel formation



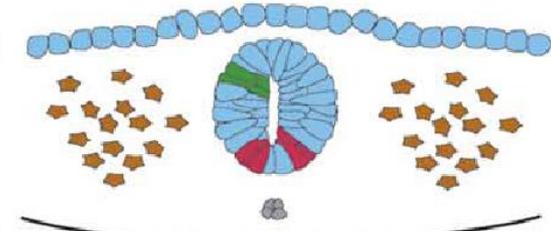
4. Neural rod formation



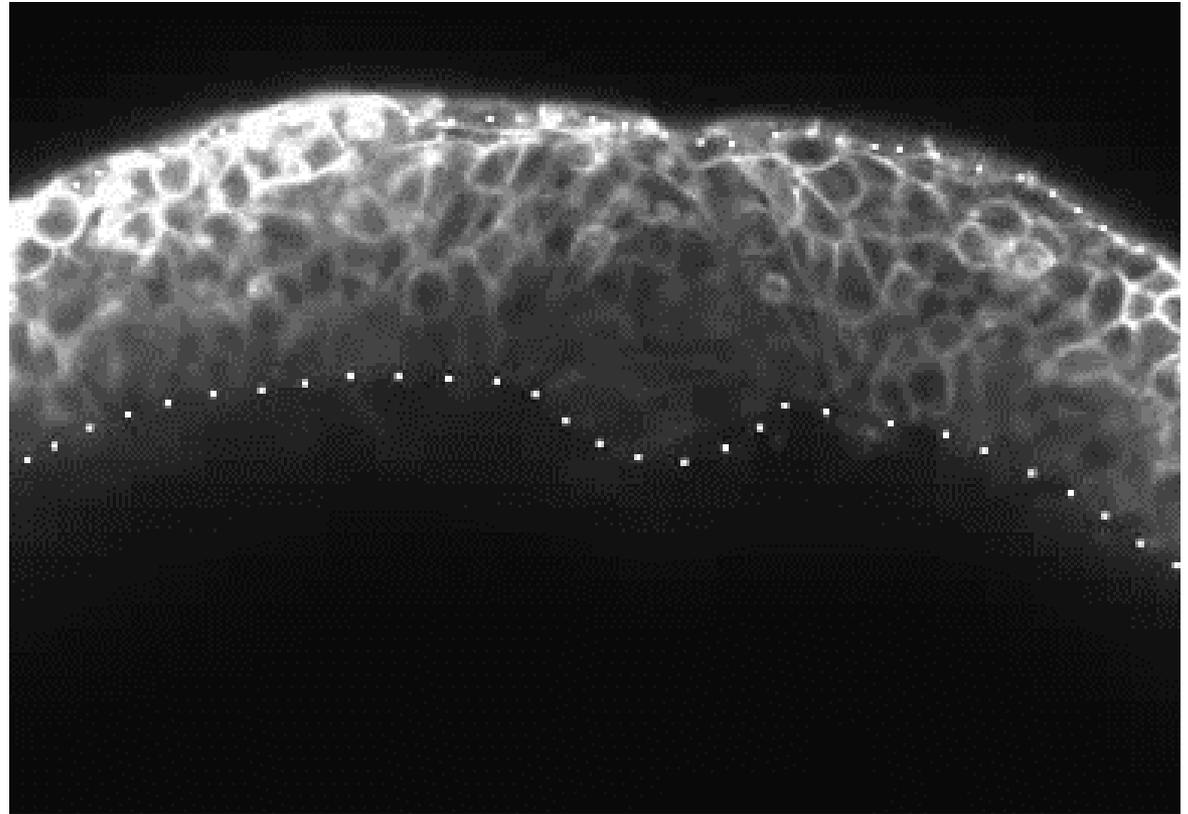
5. Lumen opening



6. Neural tube complete



<https://www.nature.com/articles/nature05722#supplementary-information>

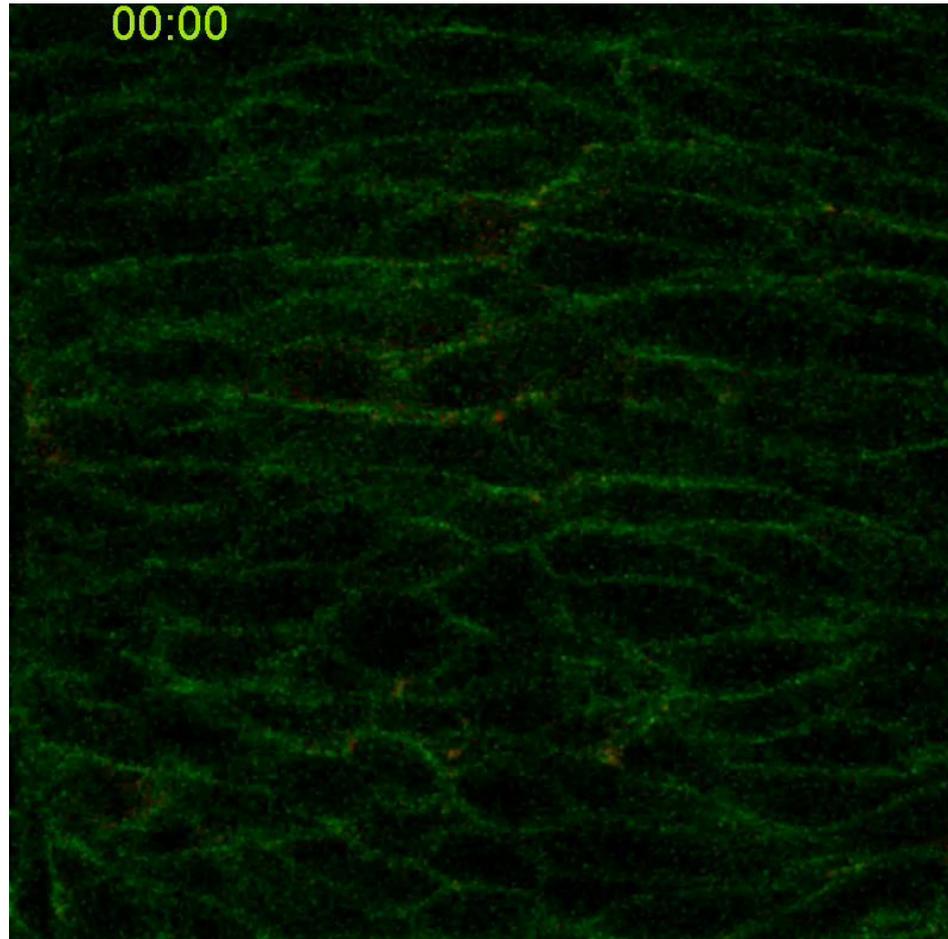


Tawk et al., 2007

Lowery and Sive, 2004

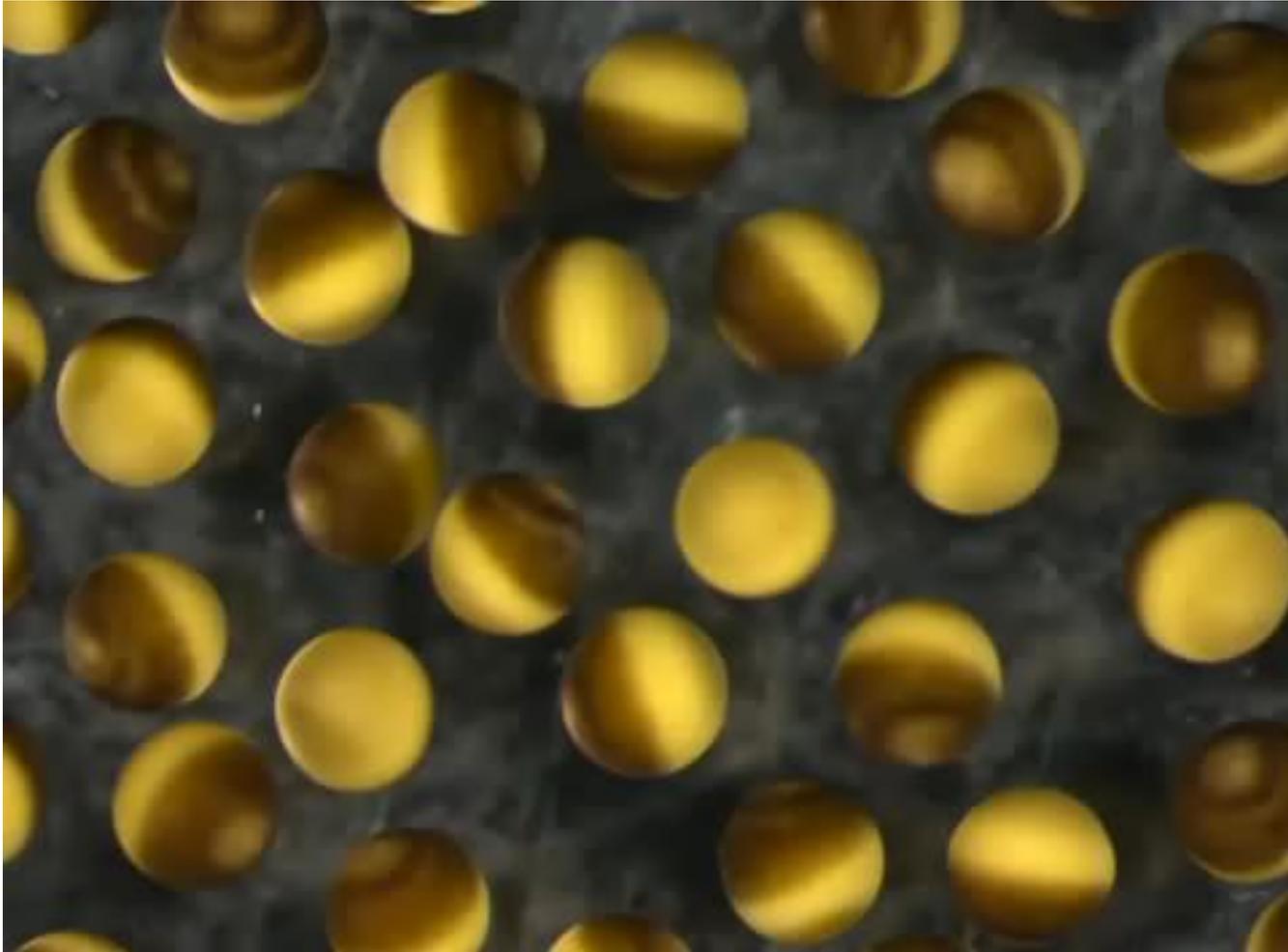
# Apical Cell-Cell Adhesions Reconcile Symmetry and Asymmetry in Zebrafish Neurulation

Chuanyu Guo,<sup>1</sup> Jian Zou,<sup>1</sup> Yi Wen,<sup>1</sup> Wei Fang,<sup>1</sup> Donna Beer Stolz,<sup>2</sup> Ming Sun,<sup>2</sup> and Xiangyun Wei<sup>1,3,4,5,\*</sup>



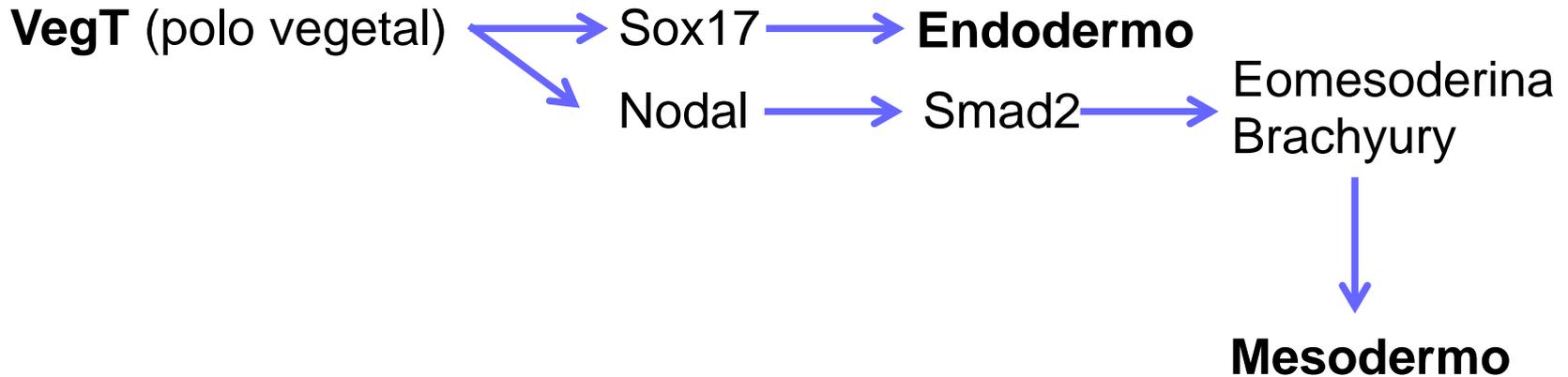
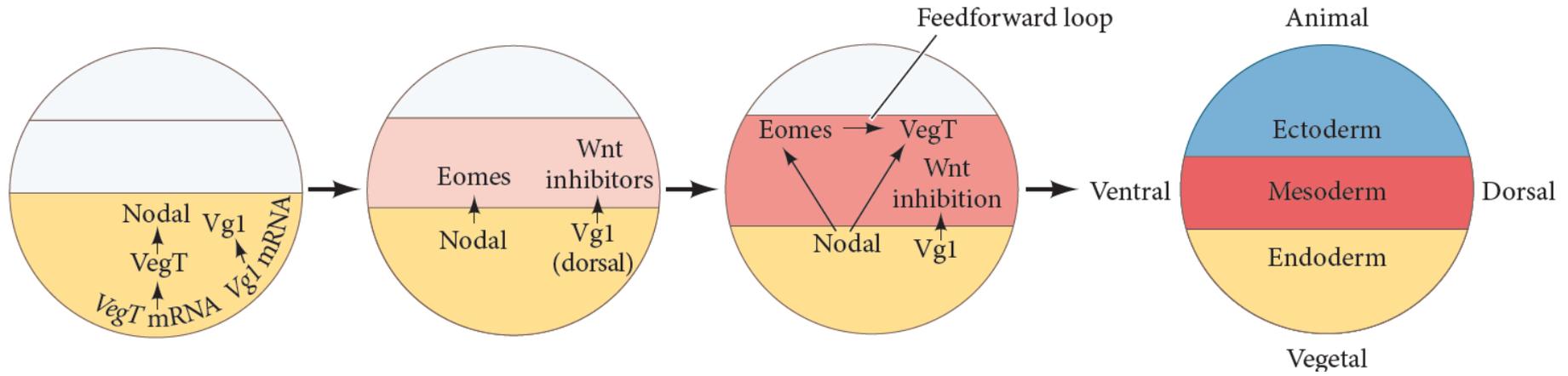
N-Cad-GFP  
ZO-1-mCherry

# Establecimiento de ejes embrionarios en anfibios



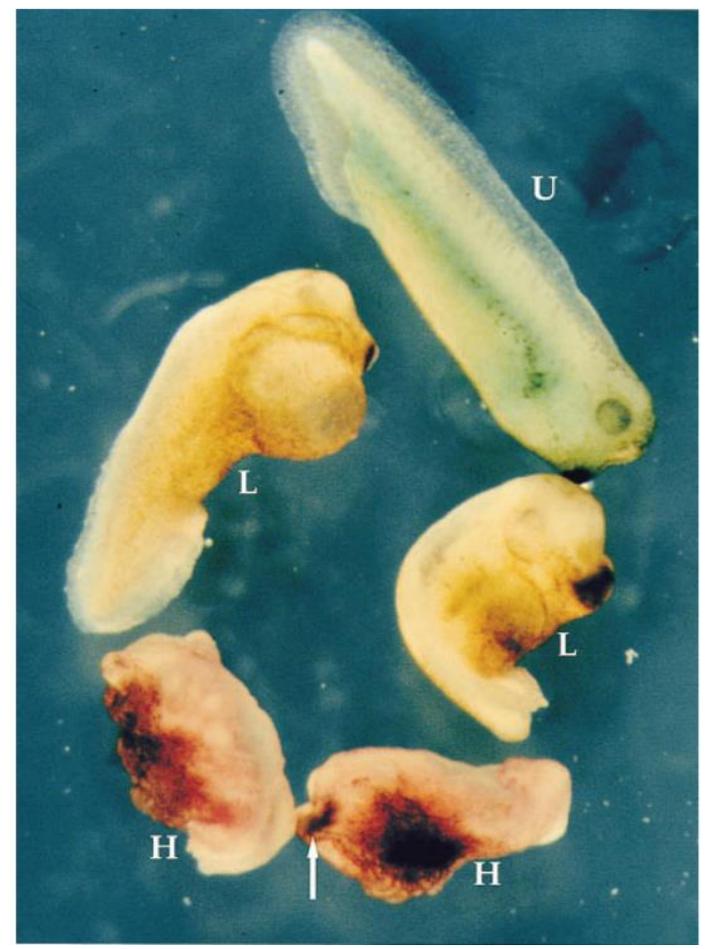
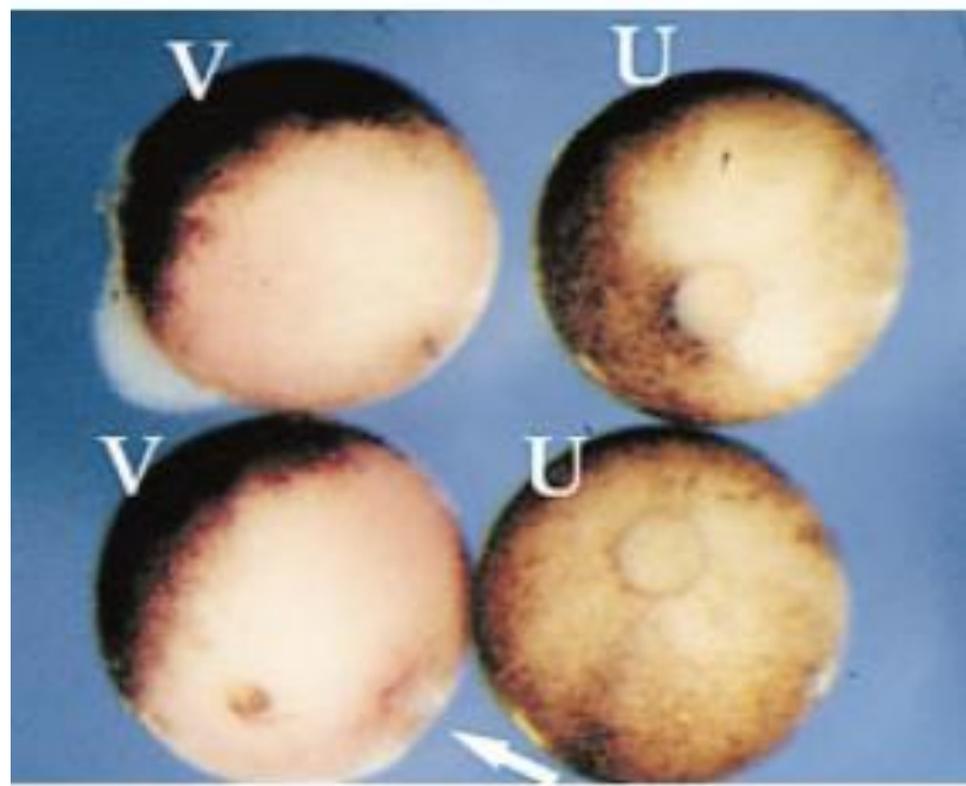
# Establecimiento de ejes embrionarios

## Especificación de las capas germinales en anfibios

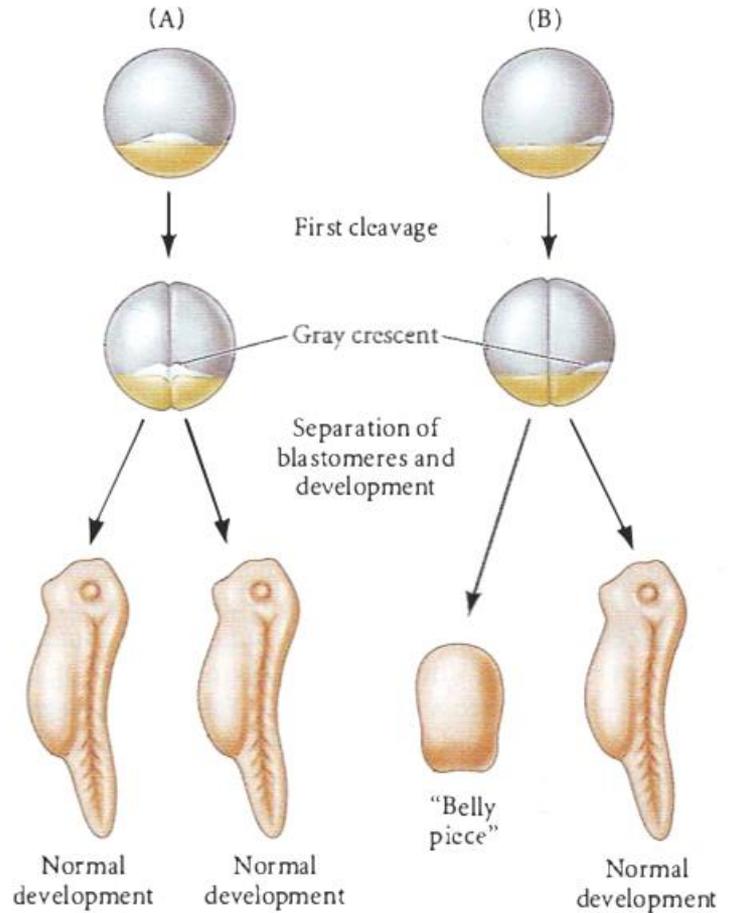
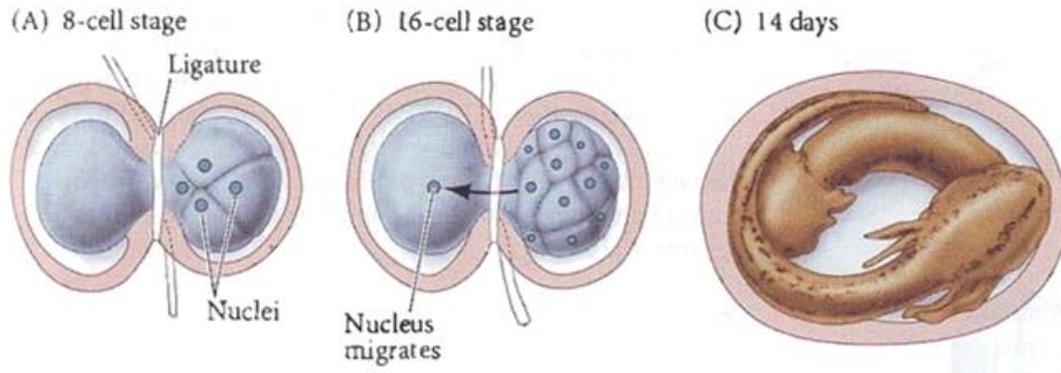


# The Role of Maternal VegT in Establishing the Primary Germ Layers in *Xenopus* Embryos

Jian Zhang,\* Douglas W. Houston,\*  
Mary Lou King,\* Christopher Payne,†  
Christopher Wylie,†† and Janet Heasman†§||



# Hans Spemann (1903)

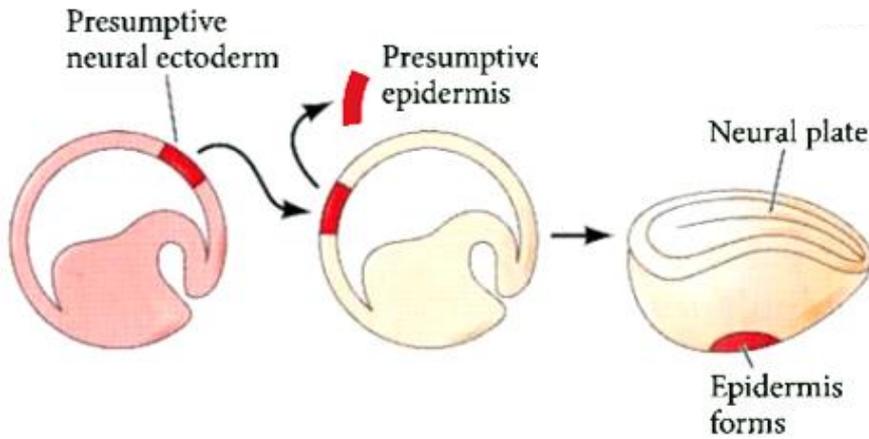


Lazo en el plano de la primer división

Lazo perpendicular al plano de la primer división

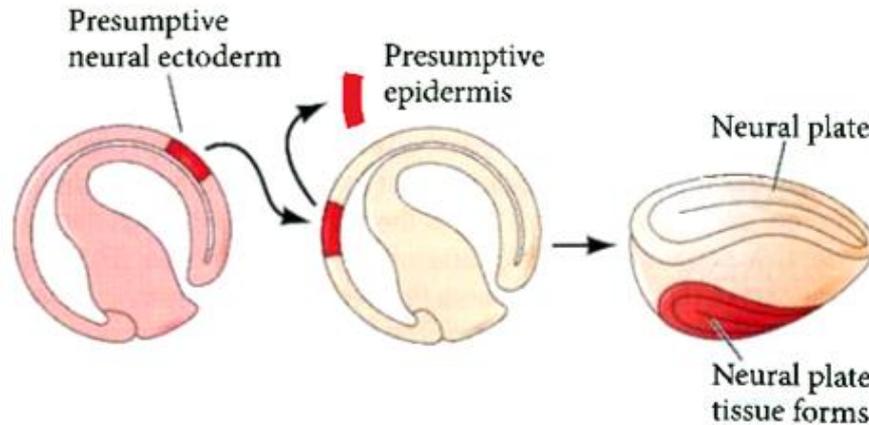
Medialuna gris → Embrión entero

## Trasplante gástrula temprana



→ Especificación condicional  
(dependiente del ambiente)

## Trasplante gástrula tardía



→ Especificación autónoma  
(independiente del ambiente)

# Establecimiento de ejes embrionarios: *El organizador*

## The Nobel Prize in Physiology or Medicine 1935

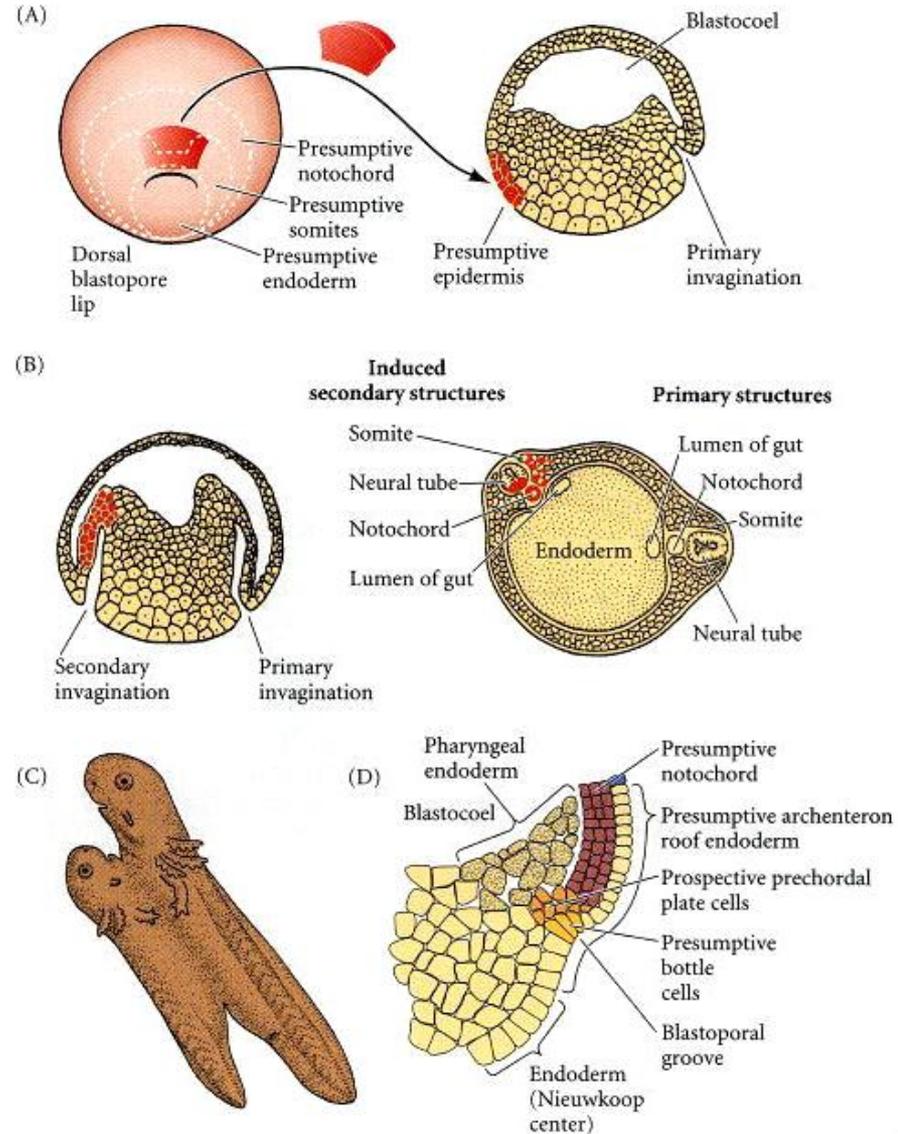


Hans Spemann  
Prize share: 1/1



Hilde Proescholdt  
Mangold

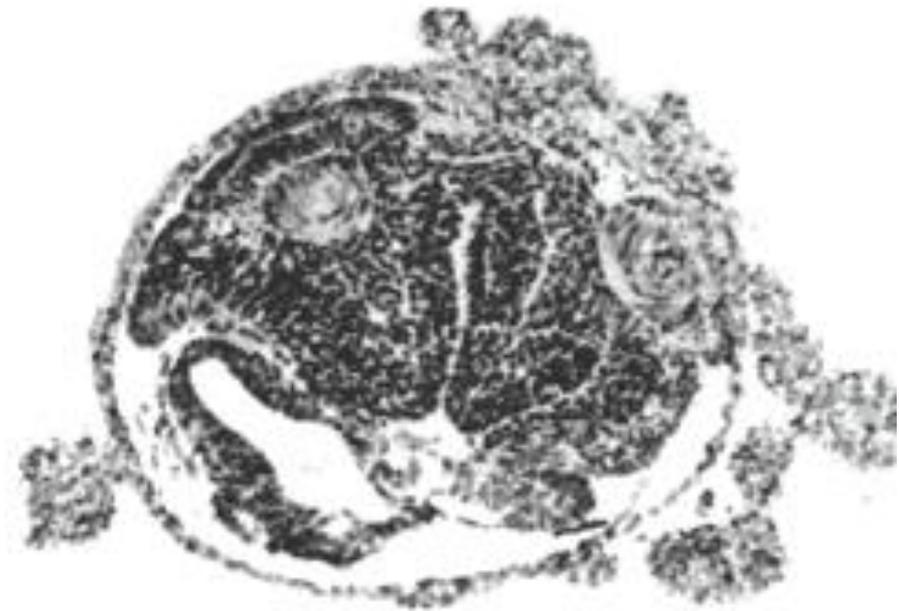
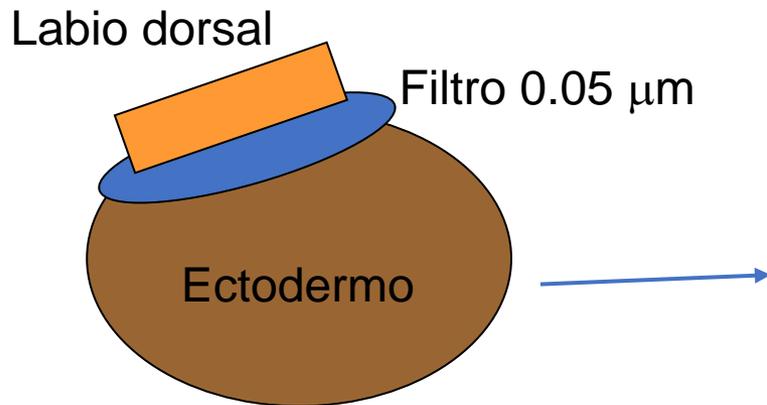
The Nobel Prize in Physiology or Medicine 1935 was awarded to Hans Spemann *"for his discovery of the organizer effect in embryonic development"*.



## Transmission Problem in Primary Induction

SULO TOIVONEN

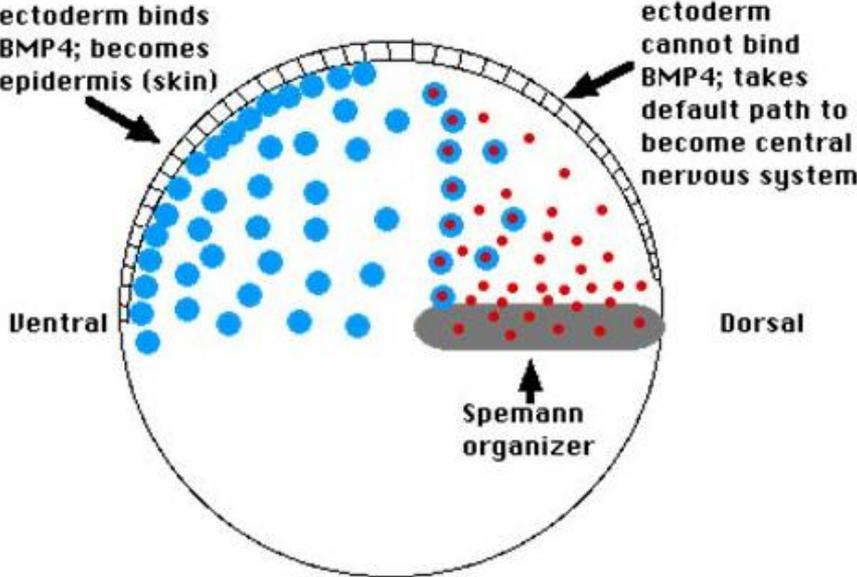
Laboratory of Experimental Embryology, University of Helsinki,  
Arkadiankatu 7, SF-00100 Helsinki 10, Finland



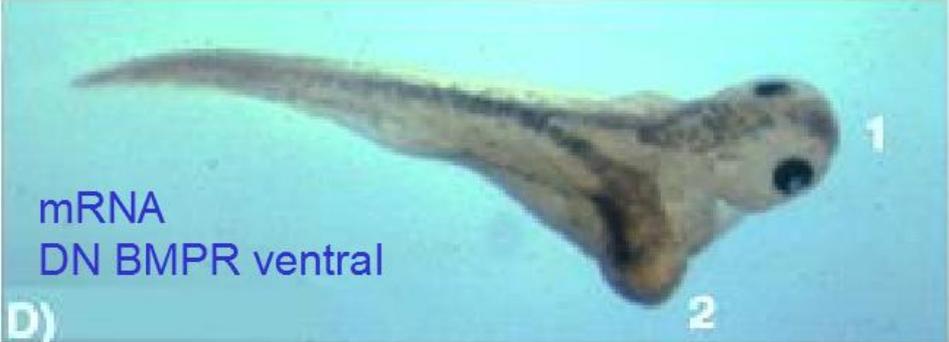
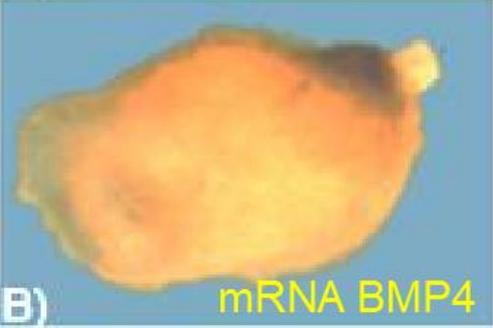
El “organizador de Spemann”

# Inducción neural

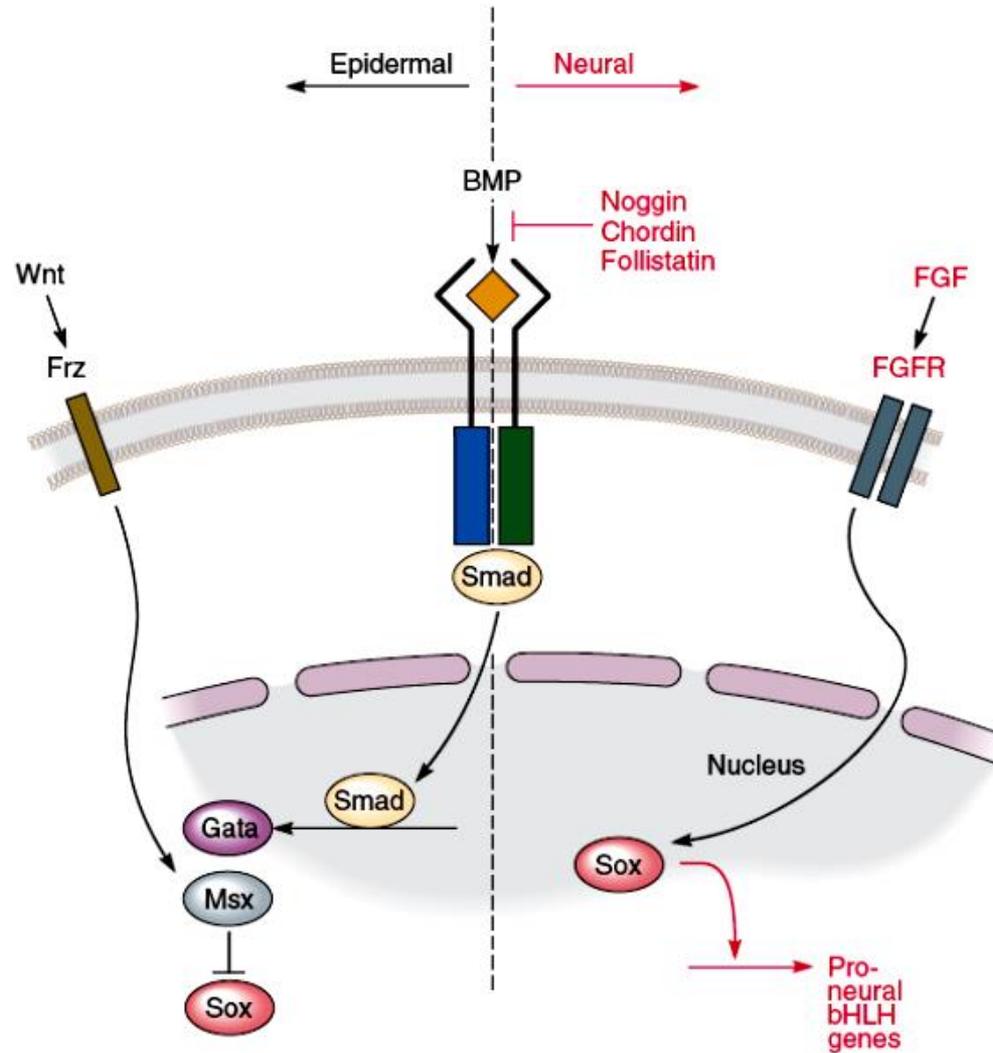
## BMPs y la hipótesis de la inducción neural “por defecto”



- = BMP4, Hwnt, others
- = chordin, noggin, others
- = inactive complexes

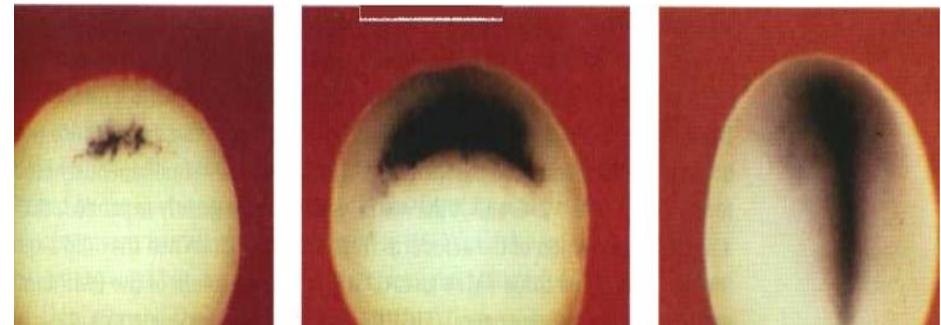
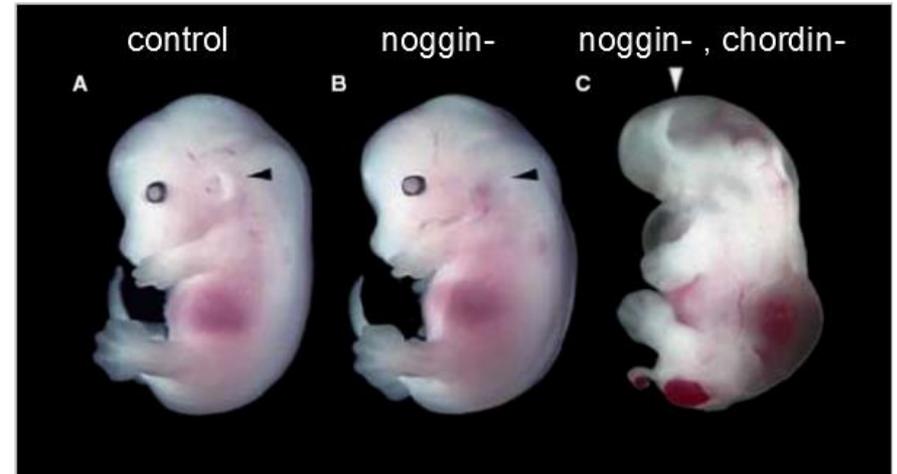


# Moléculas involucradas en la inducción neural



# Moléculas involucradas en la inducción neural: Inhibidores de BMPs

UV

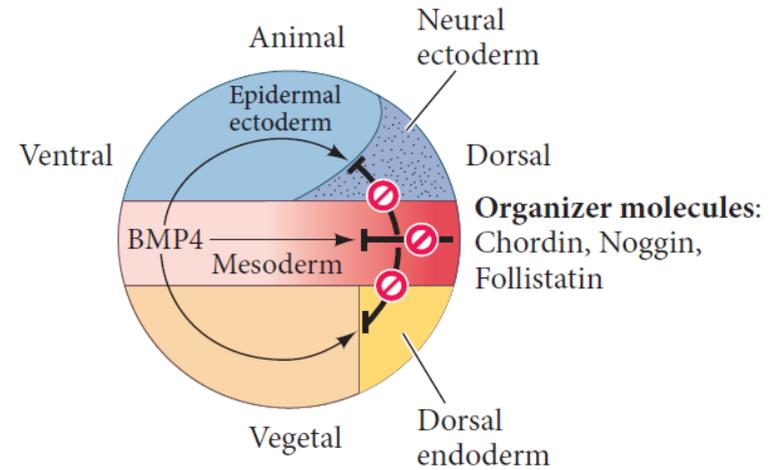
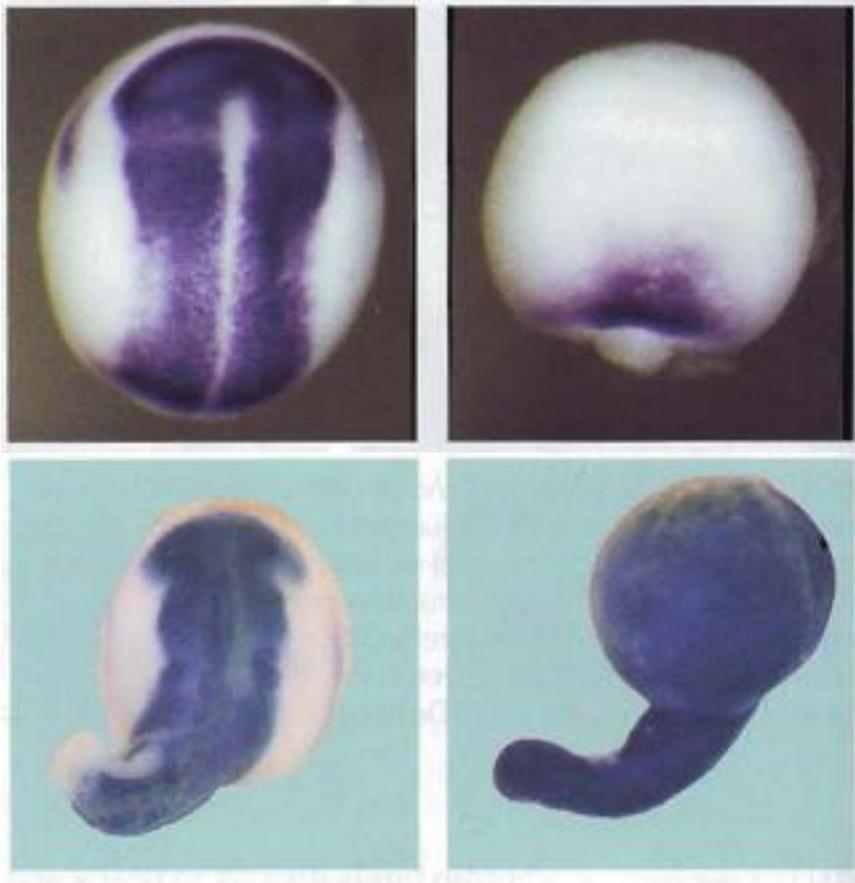


noggin

noggin

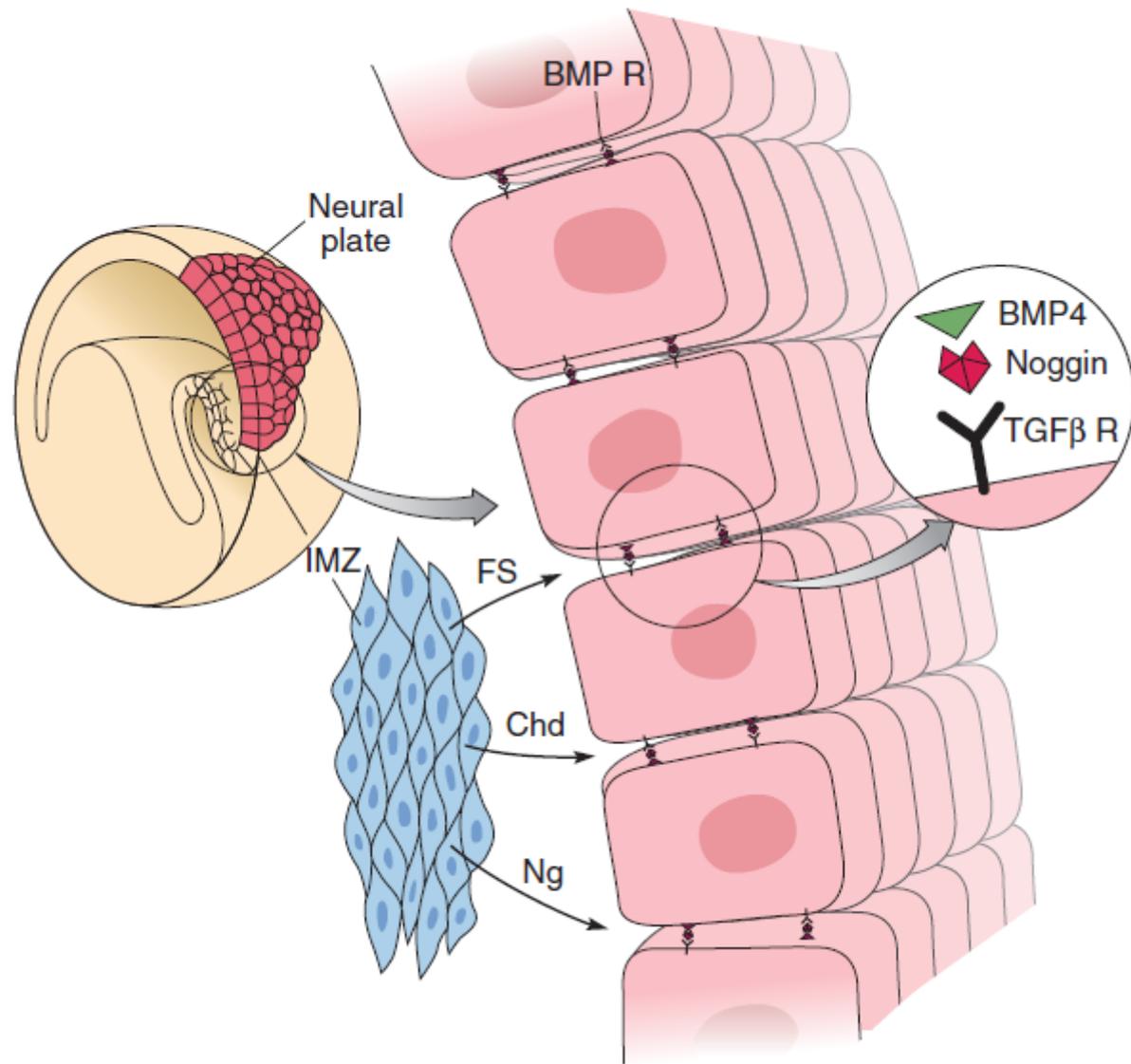
Morfolino:  
Noggin  
Chordin  
Follistatin

Control



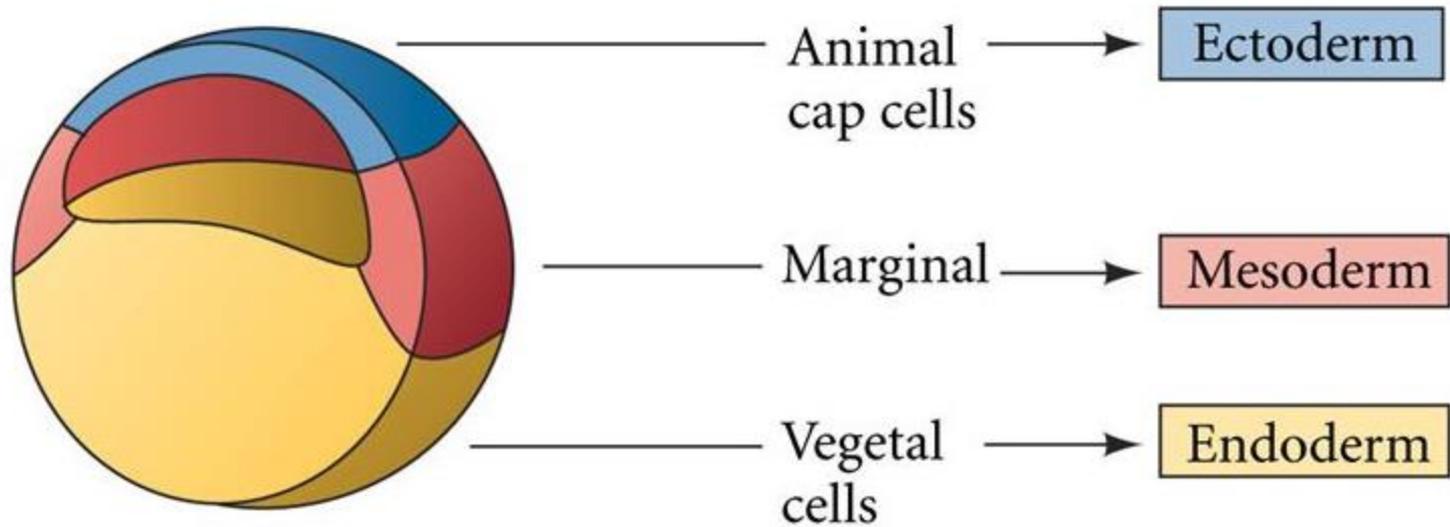
Morfolino :  
BMPs 2,4 y 7

Sox2

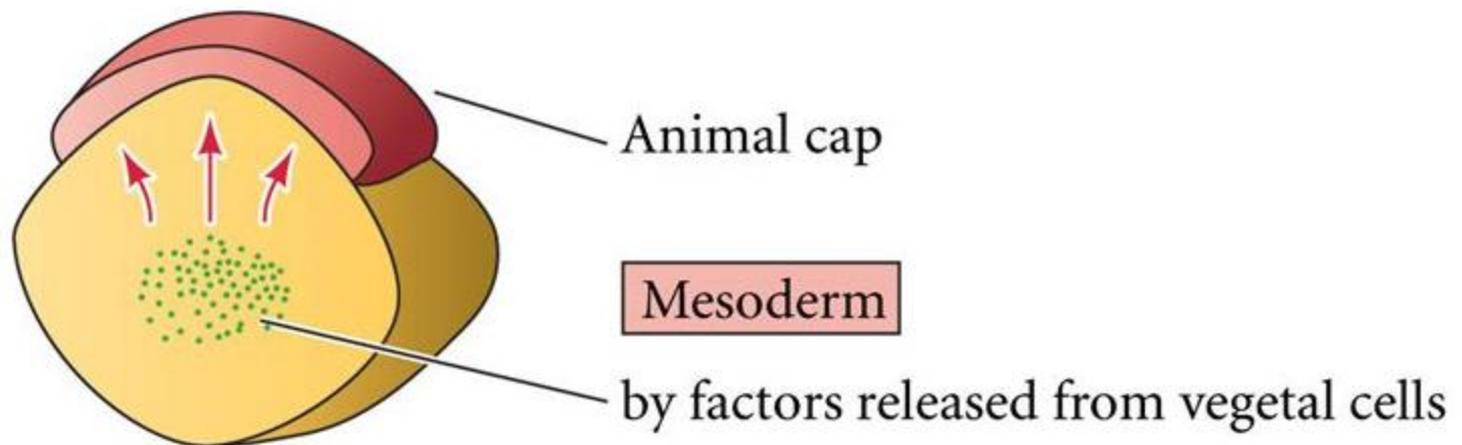


**¿Quién induce al organizador?**

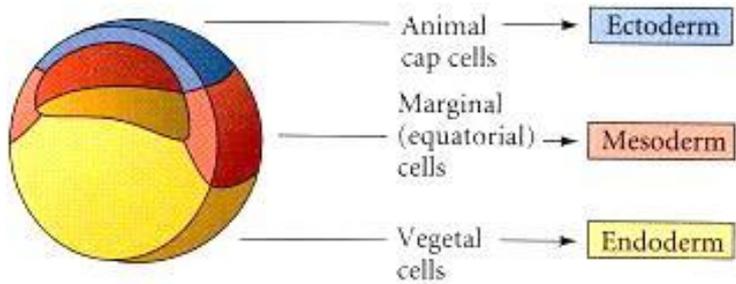
(A) Dissected blastula fragments give rise to different tissue in culture



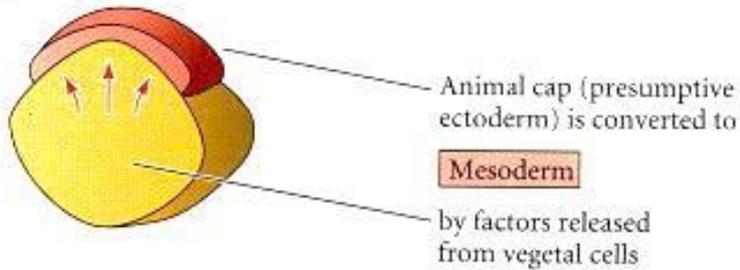
(B) Animal and vegetal fragments give rise to mesoderm



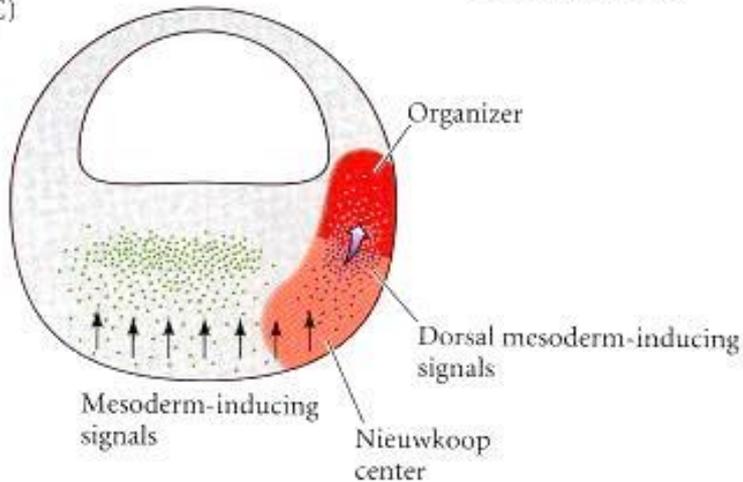
(A) Dissected blastula fragments give rise to different tissue in culture:



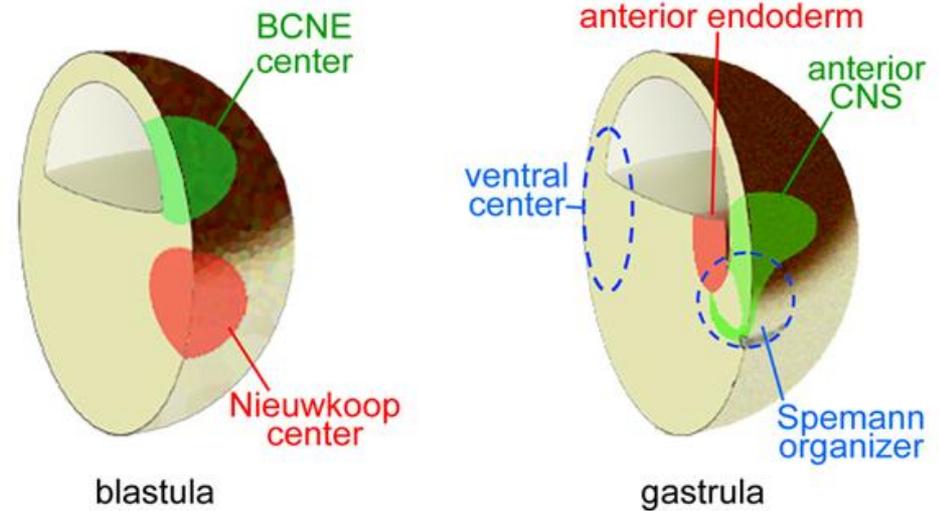
(B) Animal and vegetal fragments give mesoderm



(C)



## El “centro de Nieuwkoop”

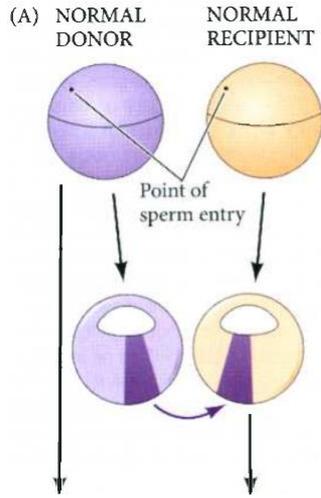


BCNE center:

Blastula Chordin/Noggin Expressing center

Nieuwkoop (1969-1977)

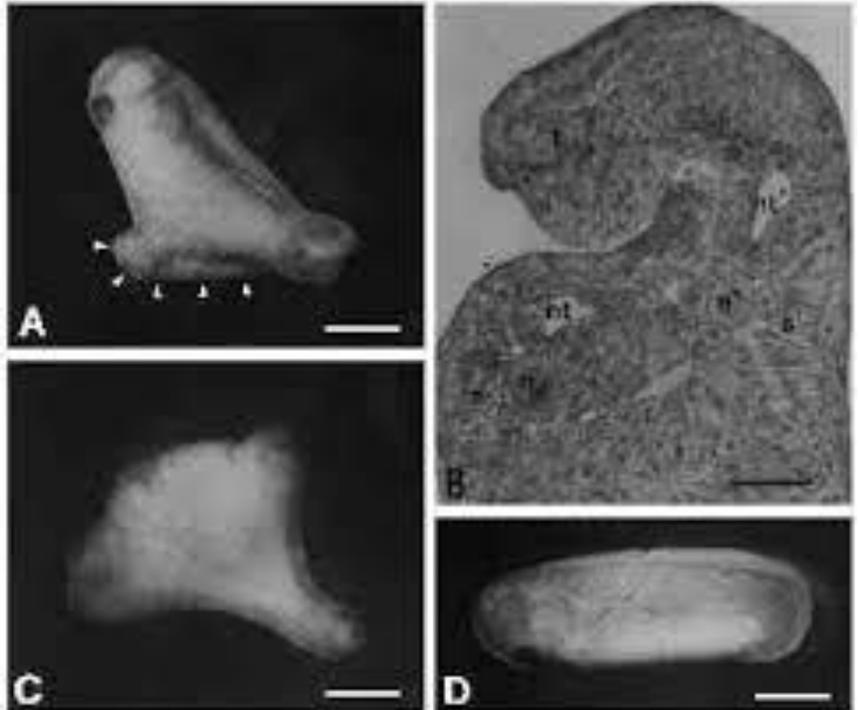
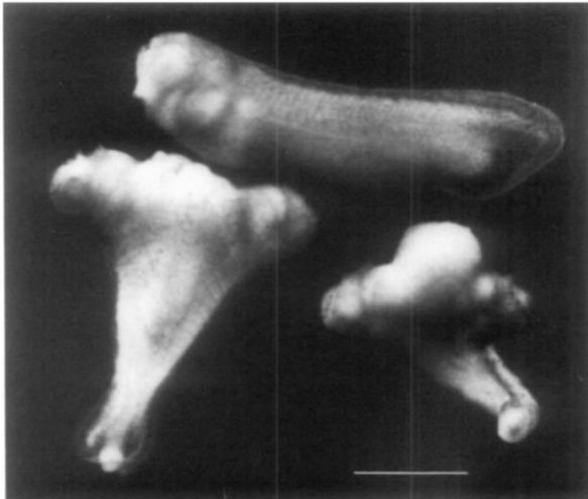
Nakamura (1970)



Development 119, 277-285 (1993)  
 Printed in Great Britain © The Company of Biologists Limited 1993

**Cortical cytoplasm, which induces dorsal axis formation in *Xenopus*, is inactivated by UV irradiation of the oocyte**

Tamara Holowacz and Richard P. Elinson



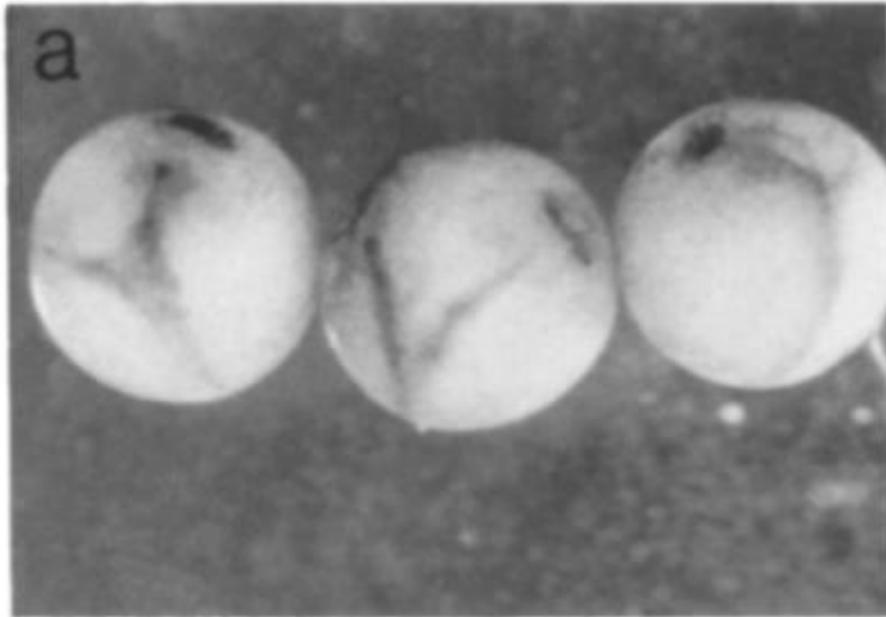
DEVELOPMENTAL BIOLOGY 104, 117-130 (1984)

**Early Cellular Interactions Promote Embryonic Axis Formation in *Xenopus laevis***

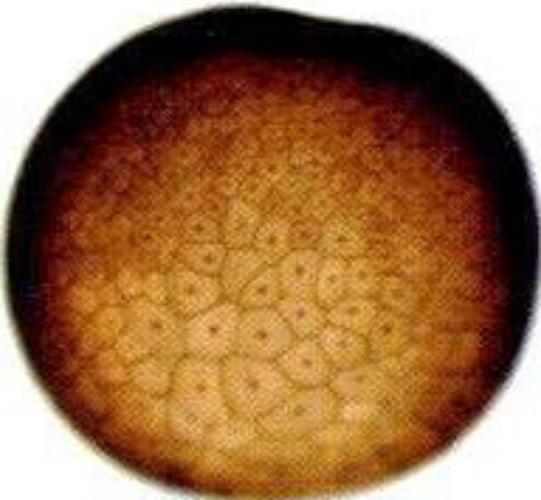
ROBERT L. GIMLICH AND JOHN C. GERHART

# Embryonic Axis Induction by the Armadillo Repeat Domain of $\beta$ -catenin: Evidence for Intracellular Signaling

Noriko Funayama, François Fagotto, Pierre McCrea,\* and Barry M. Gumbiner

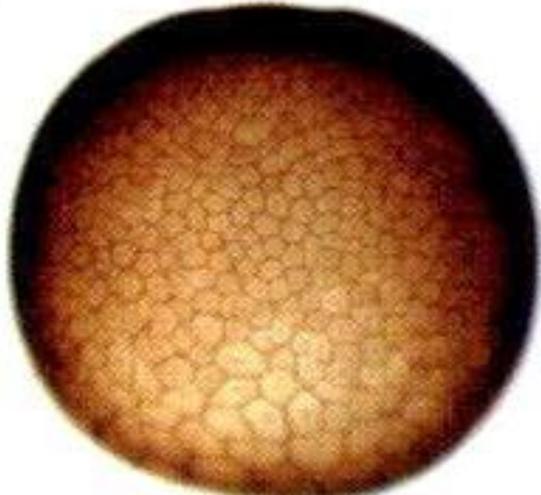


# $\beta$ -catenina



Vista dorsal

(C)

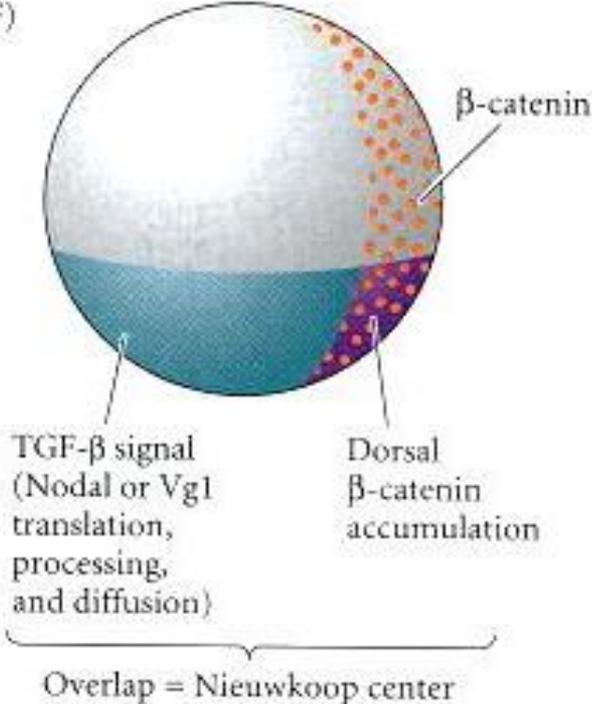


Vista ventral



GSK-3b DN

(F)



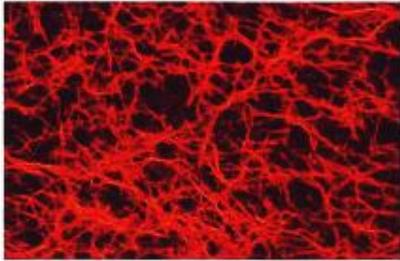
TGF- $\beta$  signal  
(Nodal or Vg1  
translation,  
processing,  
and diffusion)

Dorsal  
 $\beta$ -catenin  
accumulation

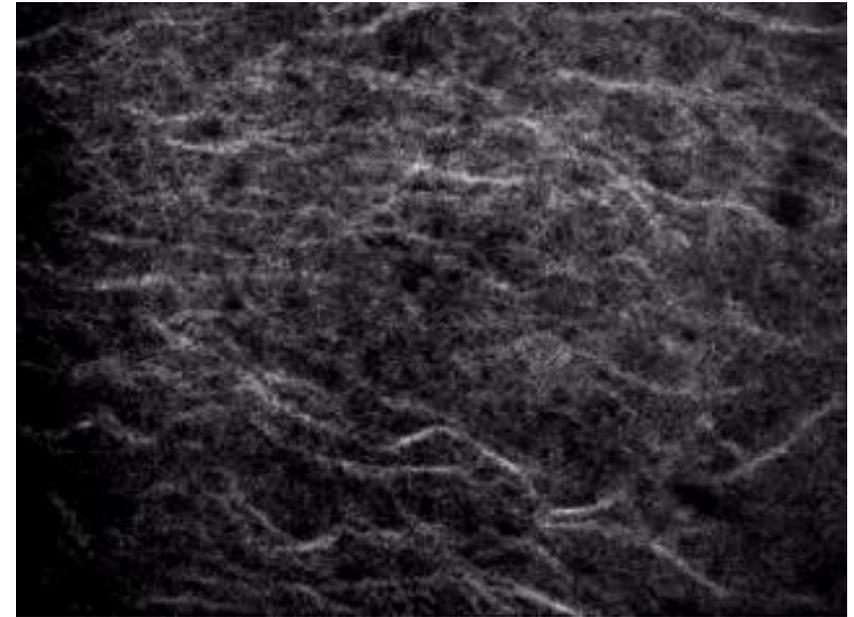
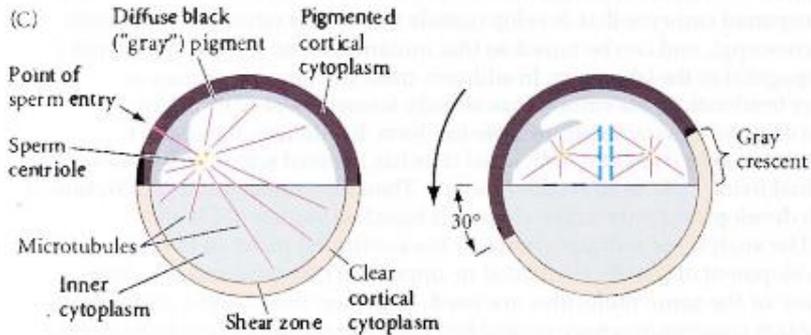
Overlap = Nieuwkoop center

# Rotación cortical

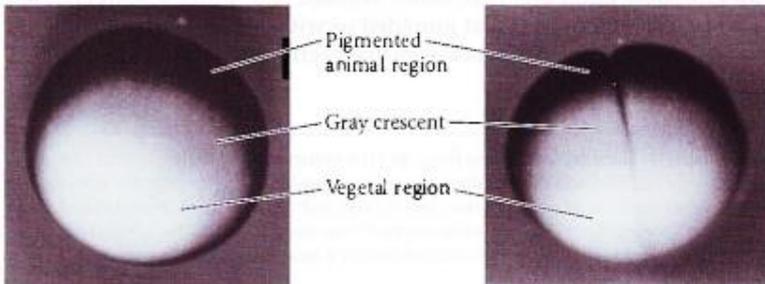
(A) 0.50



(B) 0.70



(D)



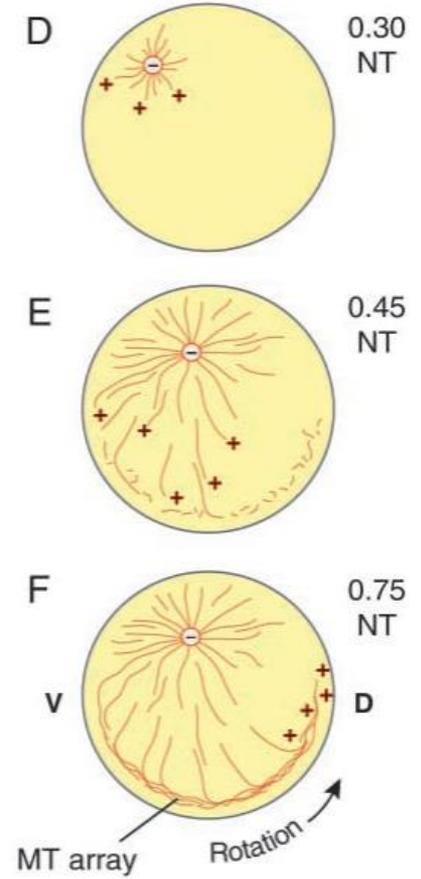
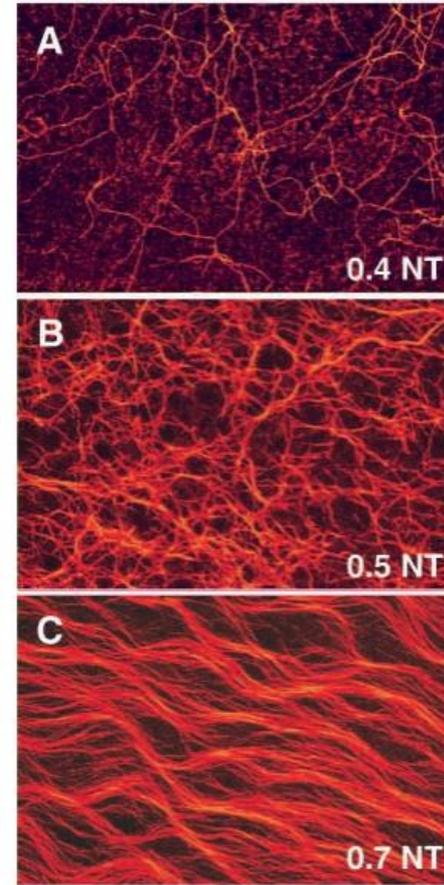
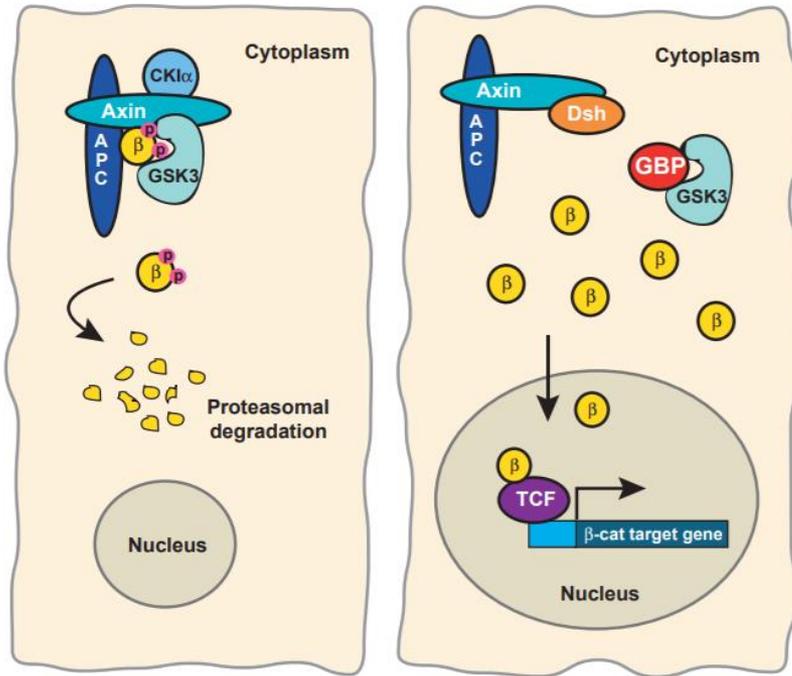
La entrada del espermatozoide marca la **región ventral** del embrión

# Move it or lose it: axis specification in *Xenopus*

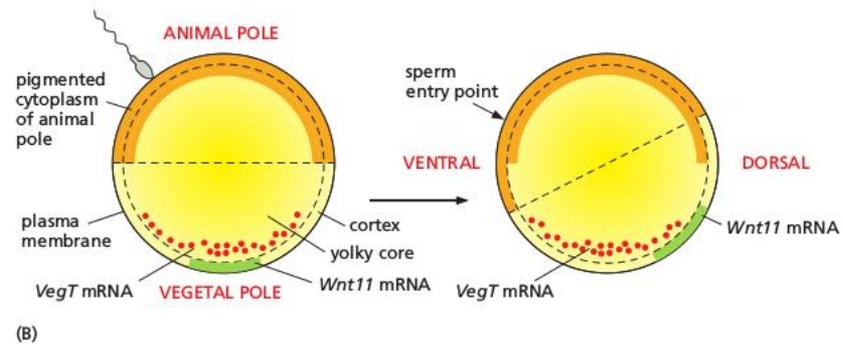
Carole Weaver and David Kimelman\*

Department of Biochemistry, Box 357350, University of Washington, Seattle, WA 98195-7350, USA  
 \*Author for correspondence (e-mail: kimelman@u.washington.edu)

Development 131, 3491-3499  
 Published by The Company of Biologists 2004  
 doi:10.1242/dev.01284

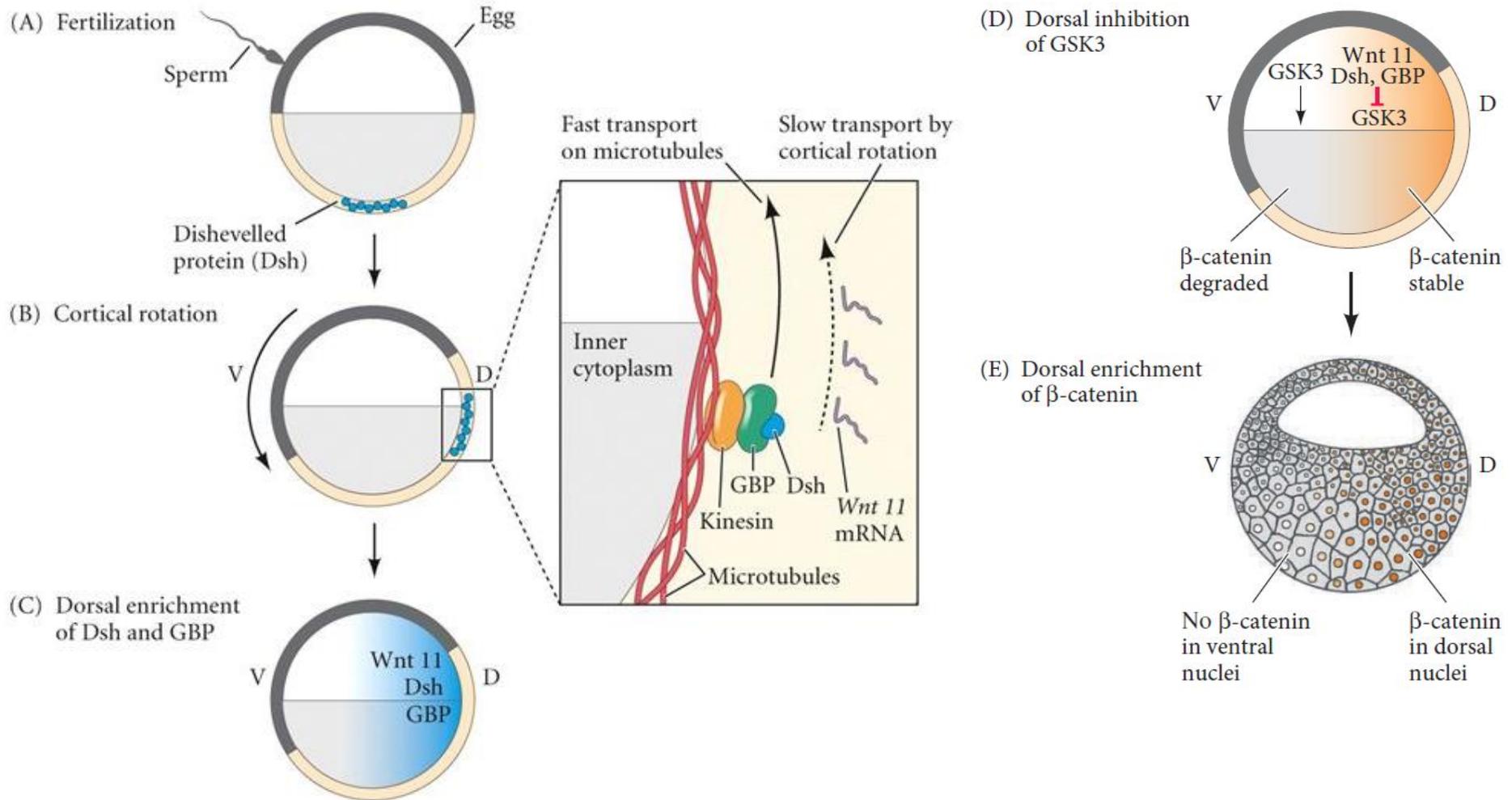


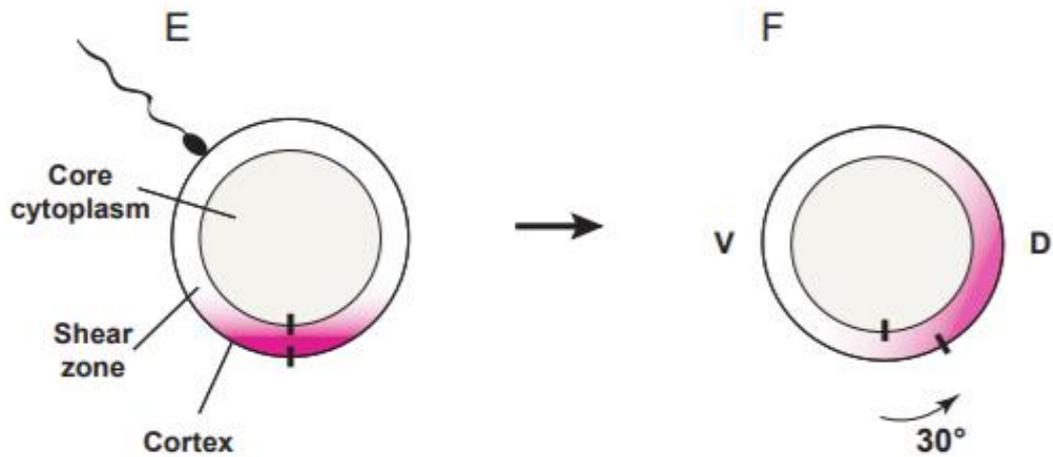
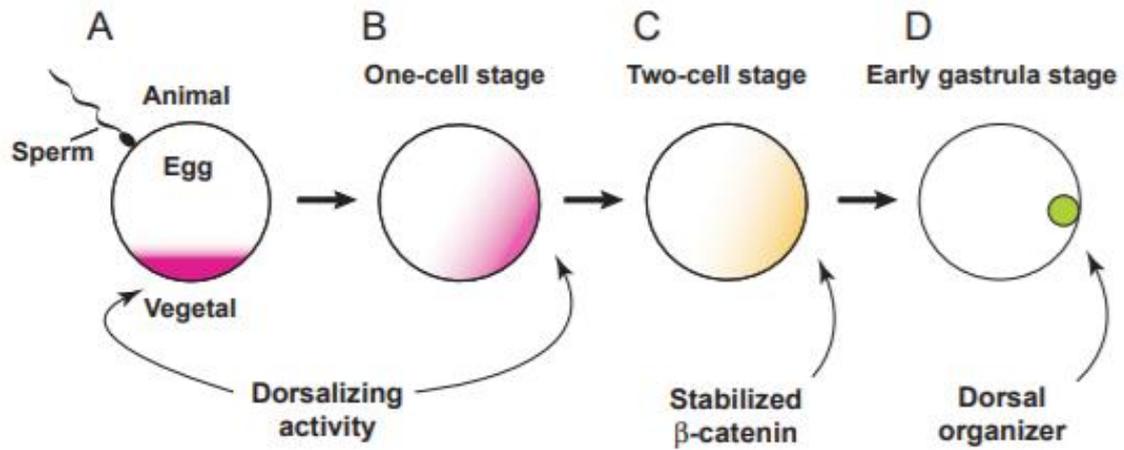
(A) 0.5 mm



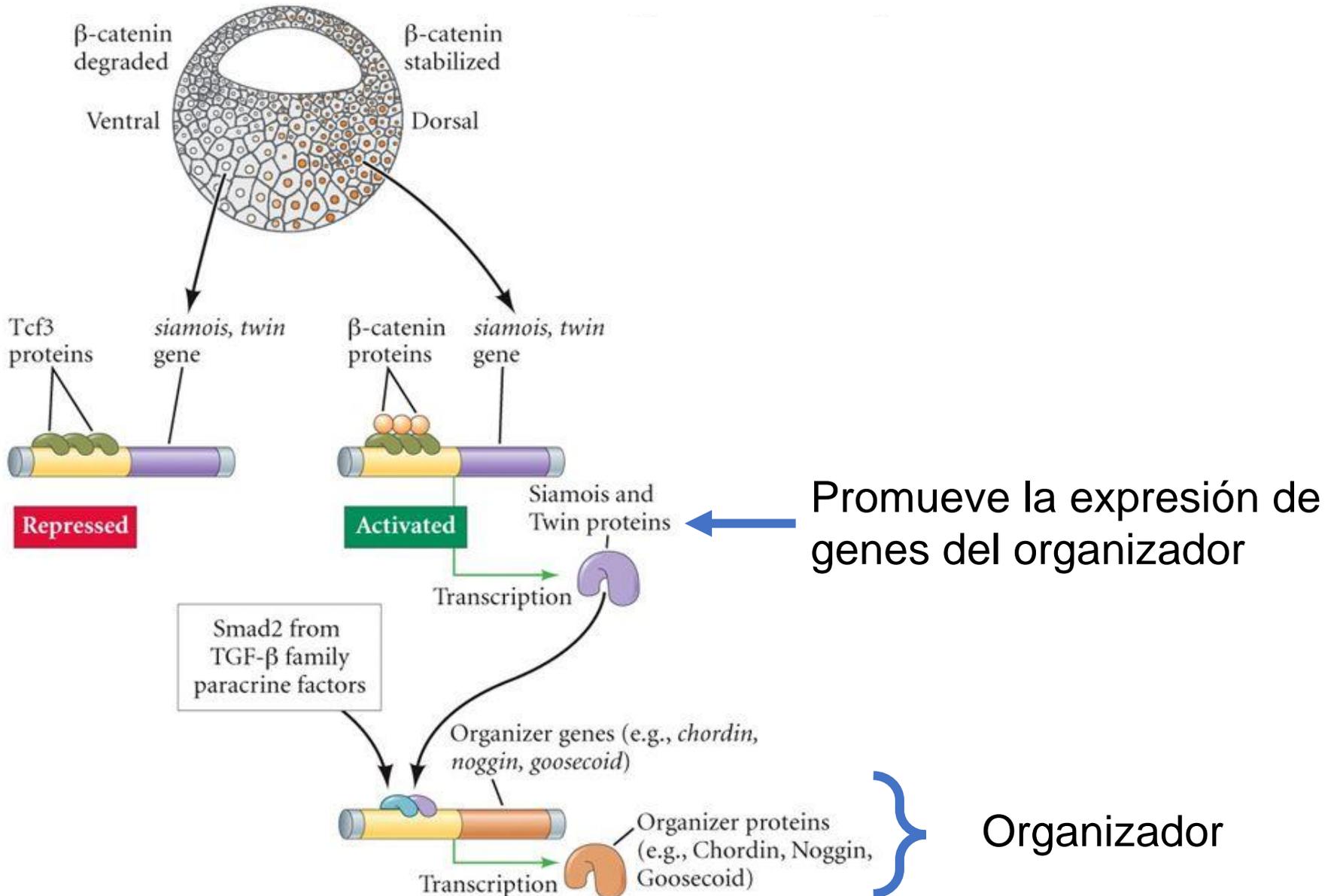
(B)

# Estabilidad de $\beta$ -catenina en región dorsal





# $\beta$ -catenina: rol en la expresión diferencial de genes



*Xenopus laevis* tailbud-stage embryo

