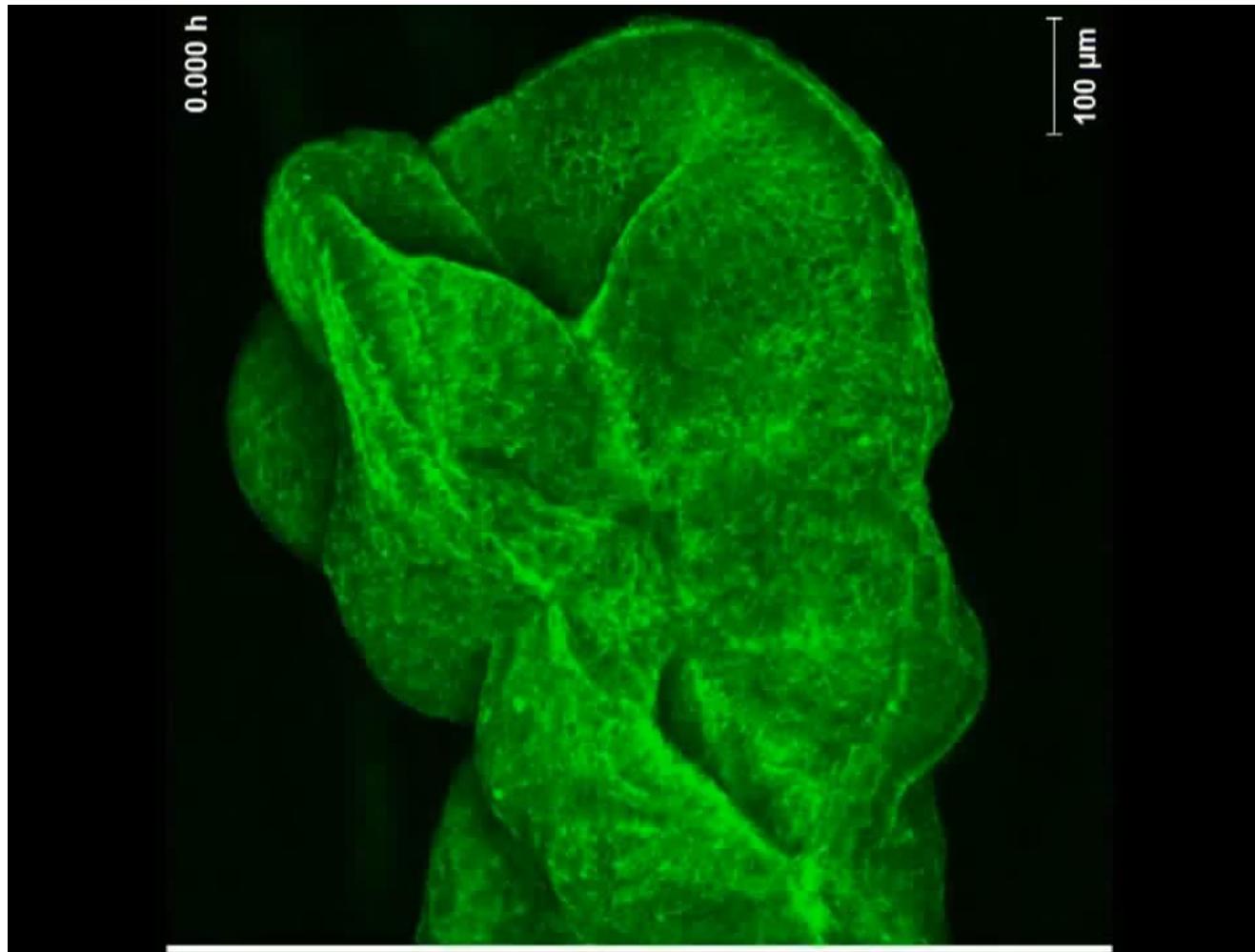


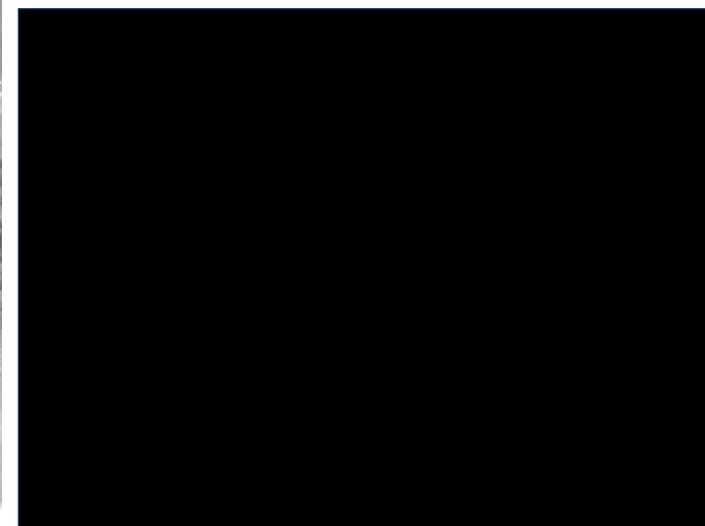
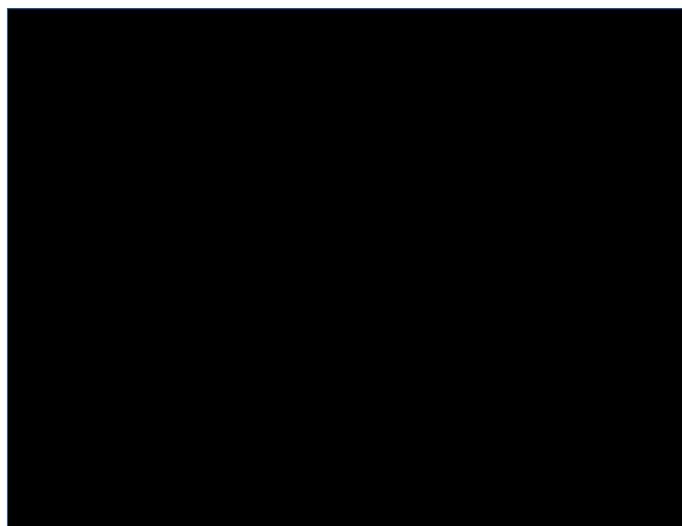
# Desarrollo temprano en metazoarios III



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

Gonzalo Aparicio  
gapericio@fcien.edu.uy

# Neurulación: cierre del tubo neural

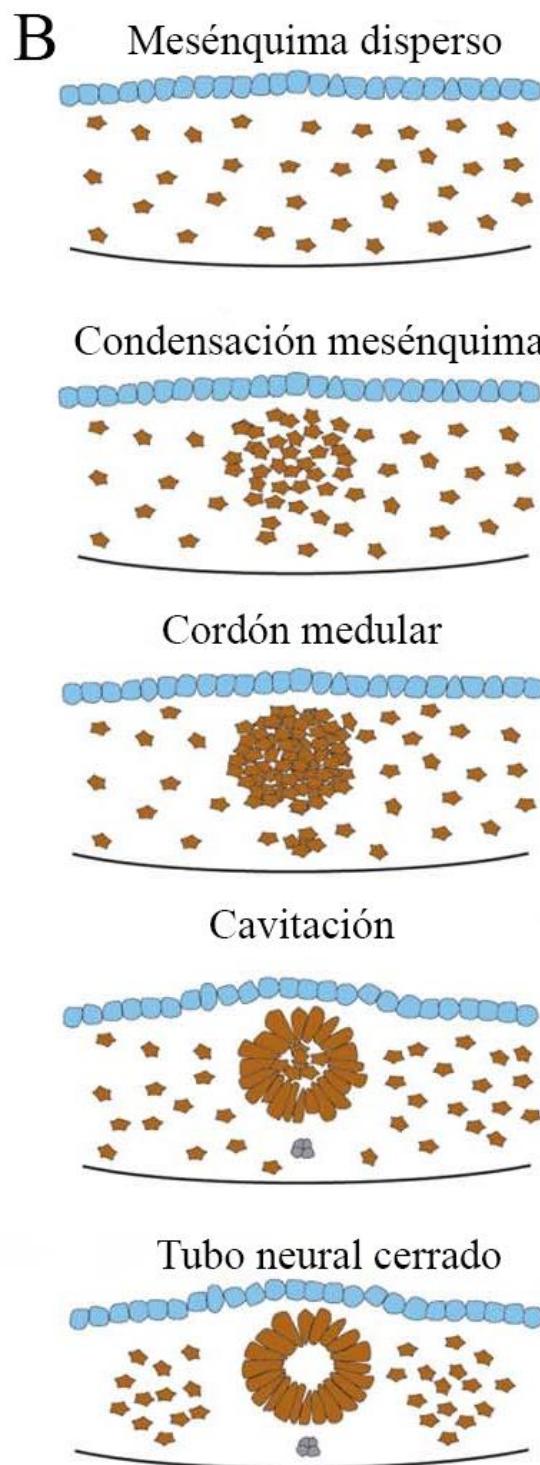
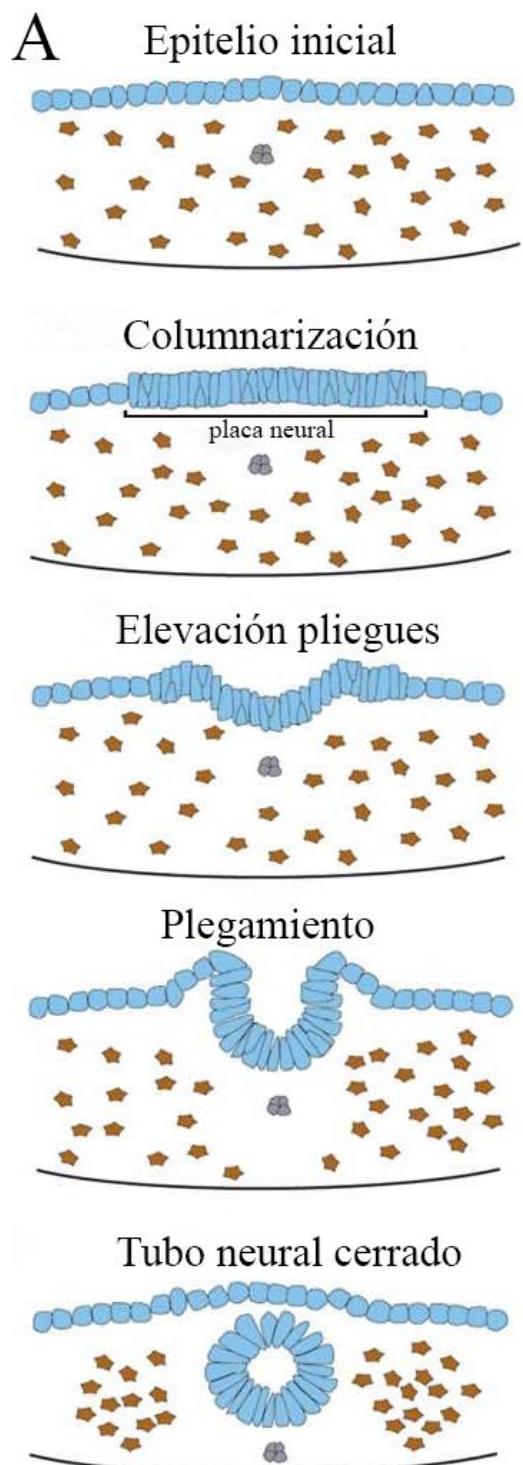


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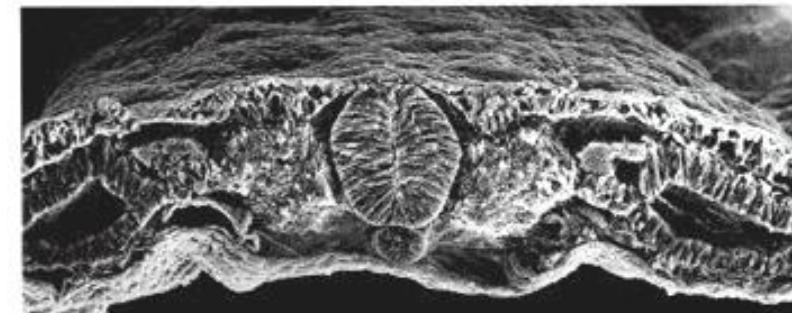
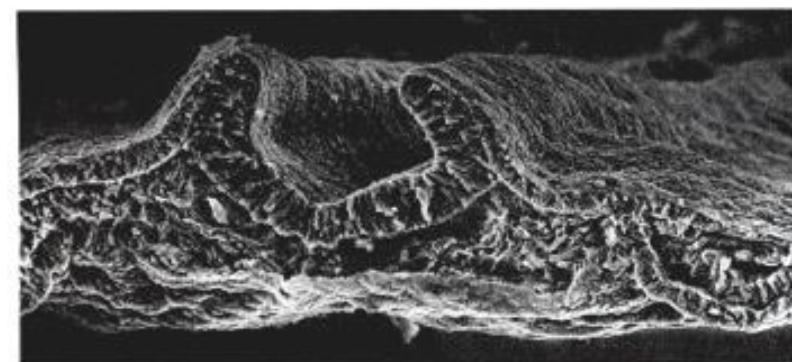


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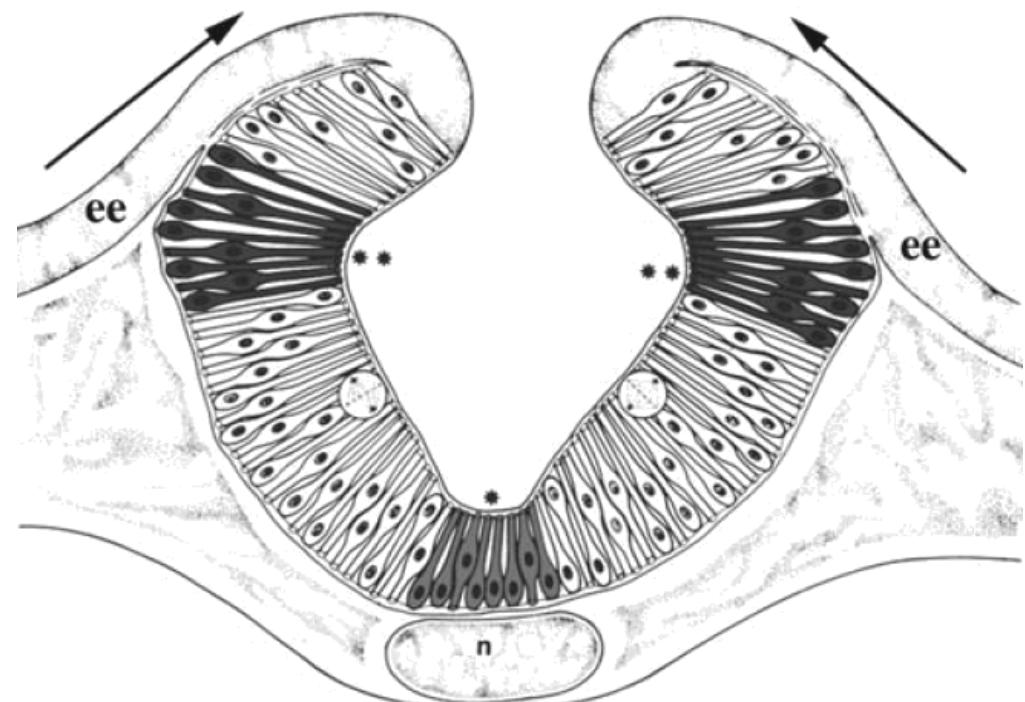
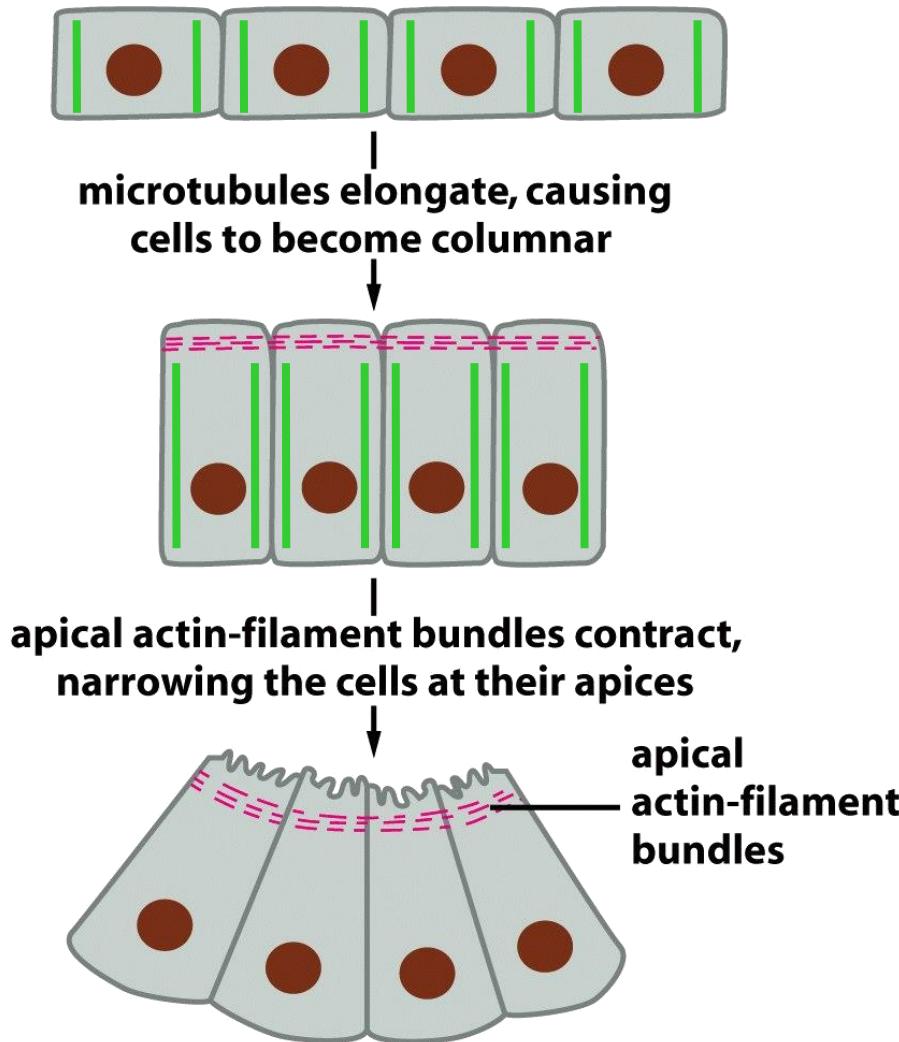
<https://www.youtube.com/watch?v=u52pTxg75s>



# Cierre del tubo neural: Neurulación primaria

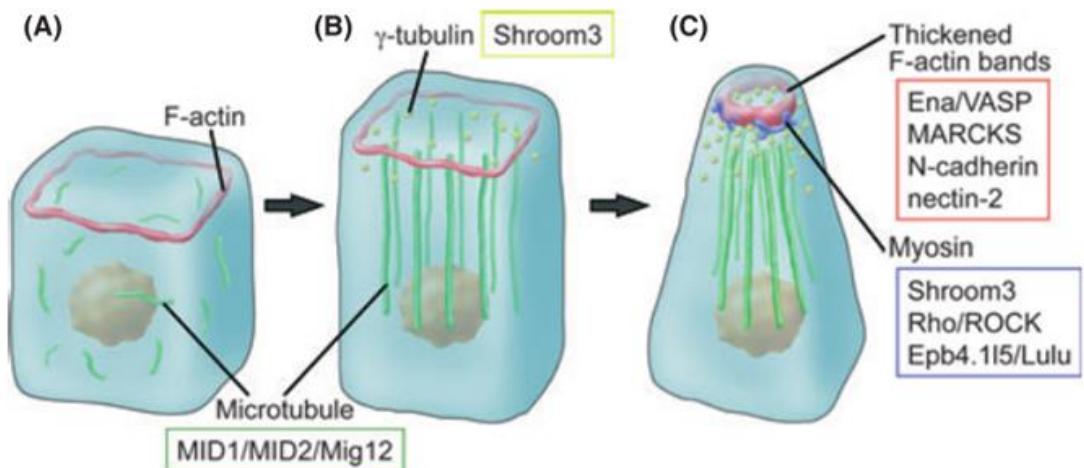


# Fuerzas intrínsecas/extrínsecas a la placa neural

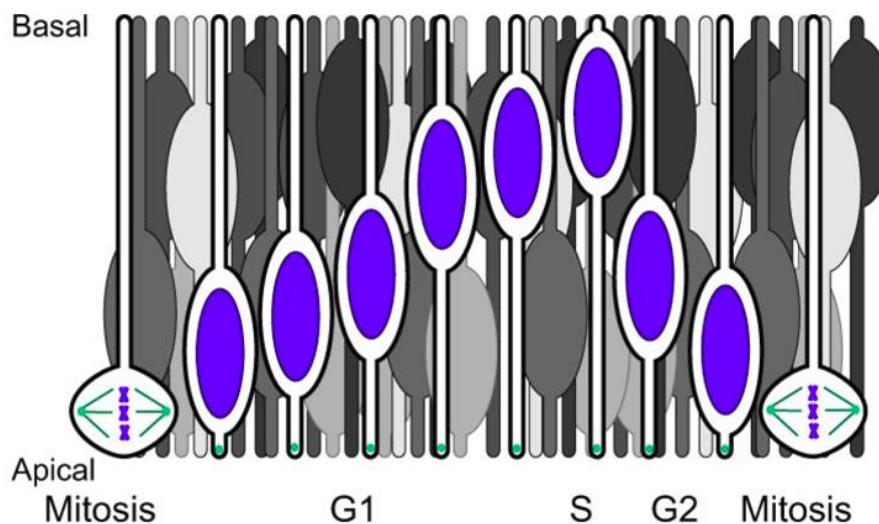


# Formación de puntos de bisagra

Constricción apical



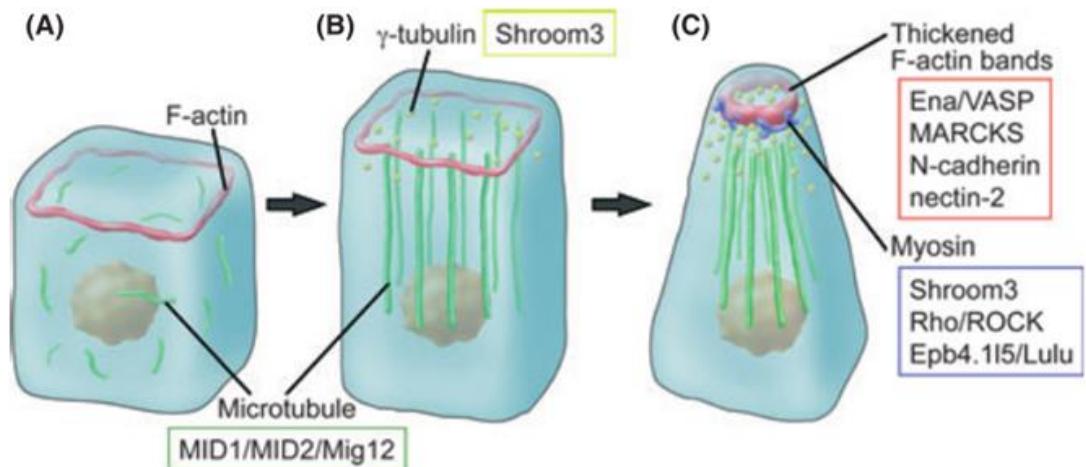
Ensanchamiento basal



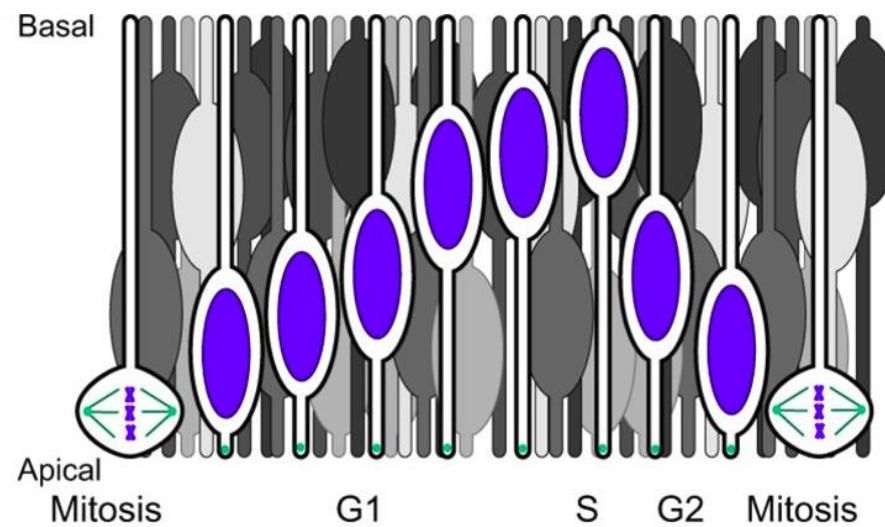
Migración nuclear intercinética

# Formación de puntos de bisagra

Constricción apical



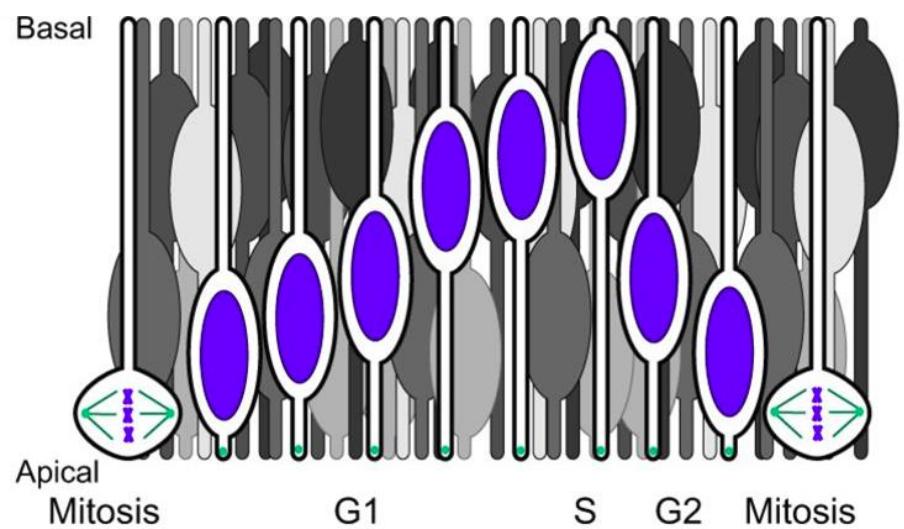
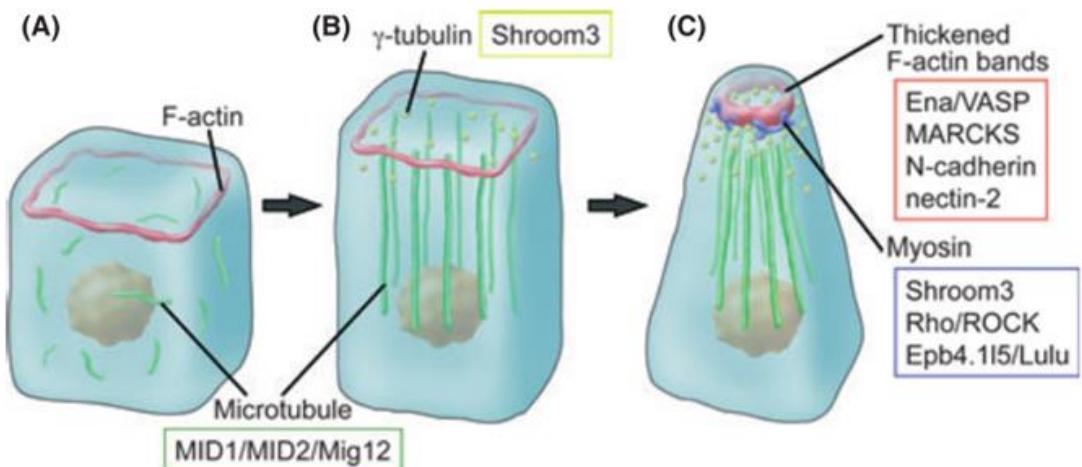
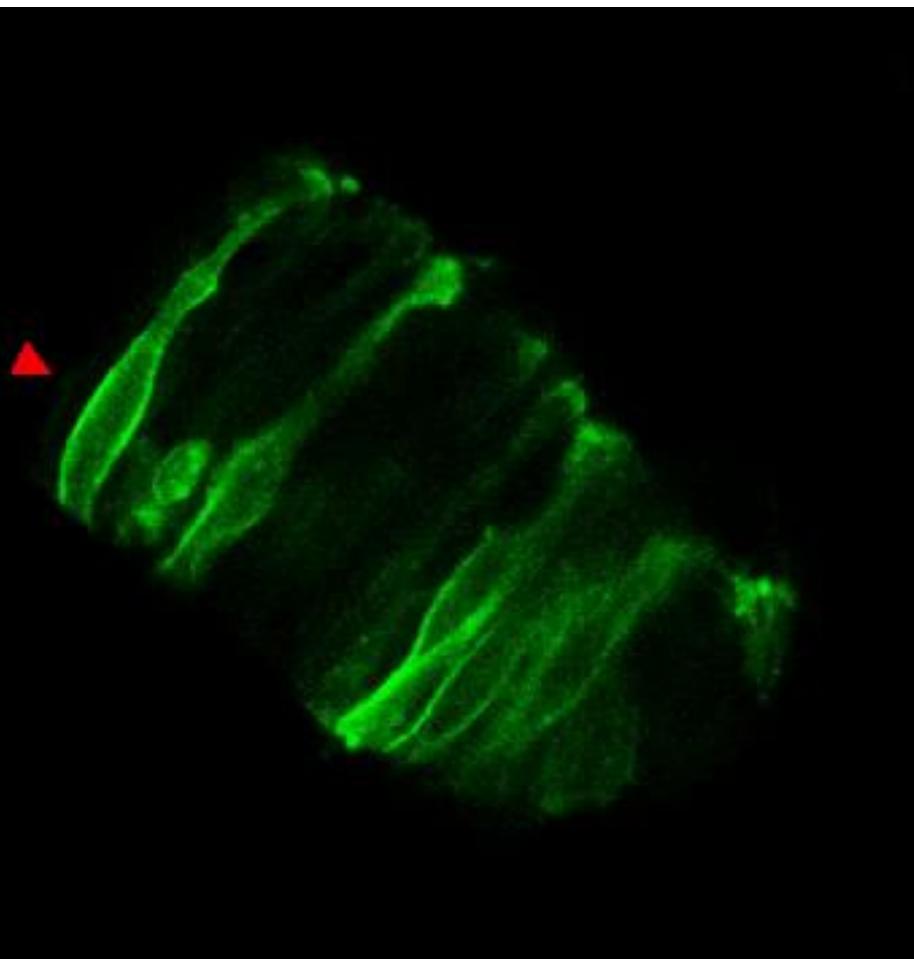
Ensanchamiento basal



Migración nuclear intercinética

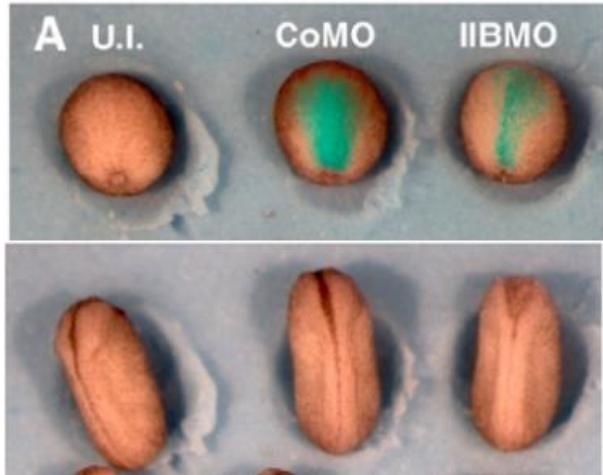
# Formación de puntos de bisagra

<https://www.youtube.com/watch?v=WB-ckDM-ukY&feature=youtu.be>

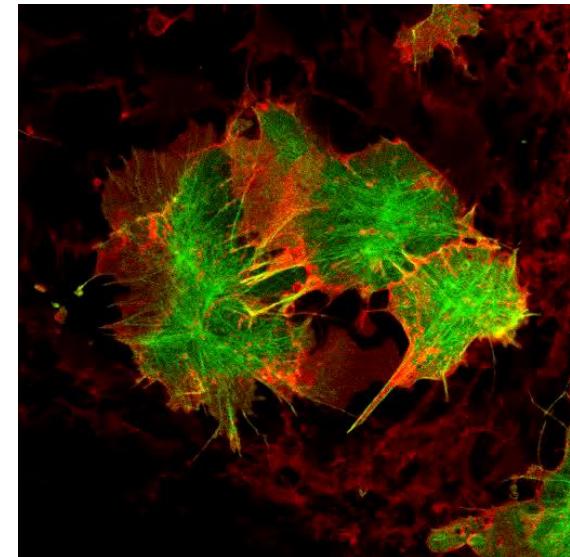


Migración nuclear intercinética

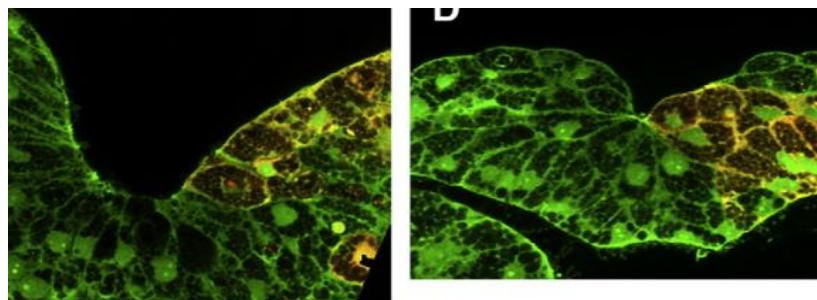
# Cierre del tubo neural: movimientos celulares y citoesqueleto de actina



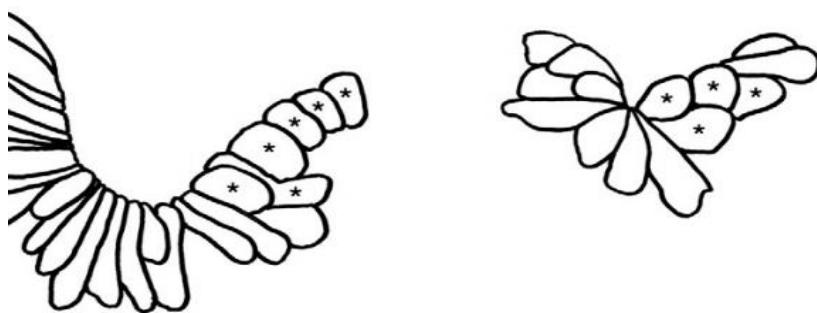
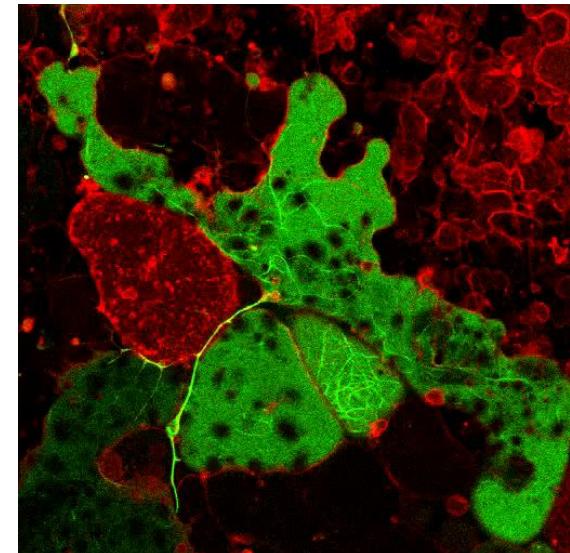
Control



Miosina IIB

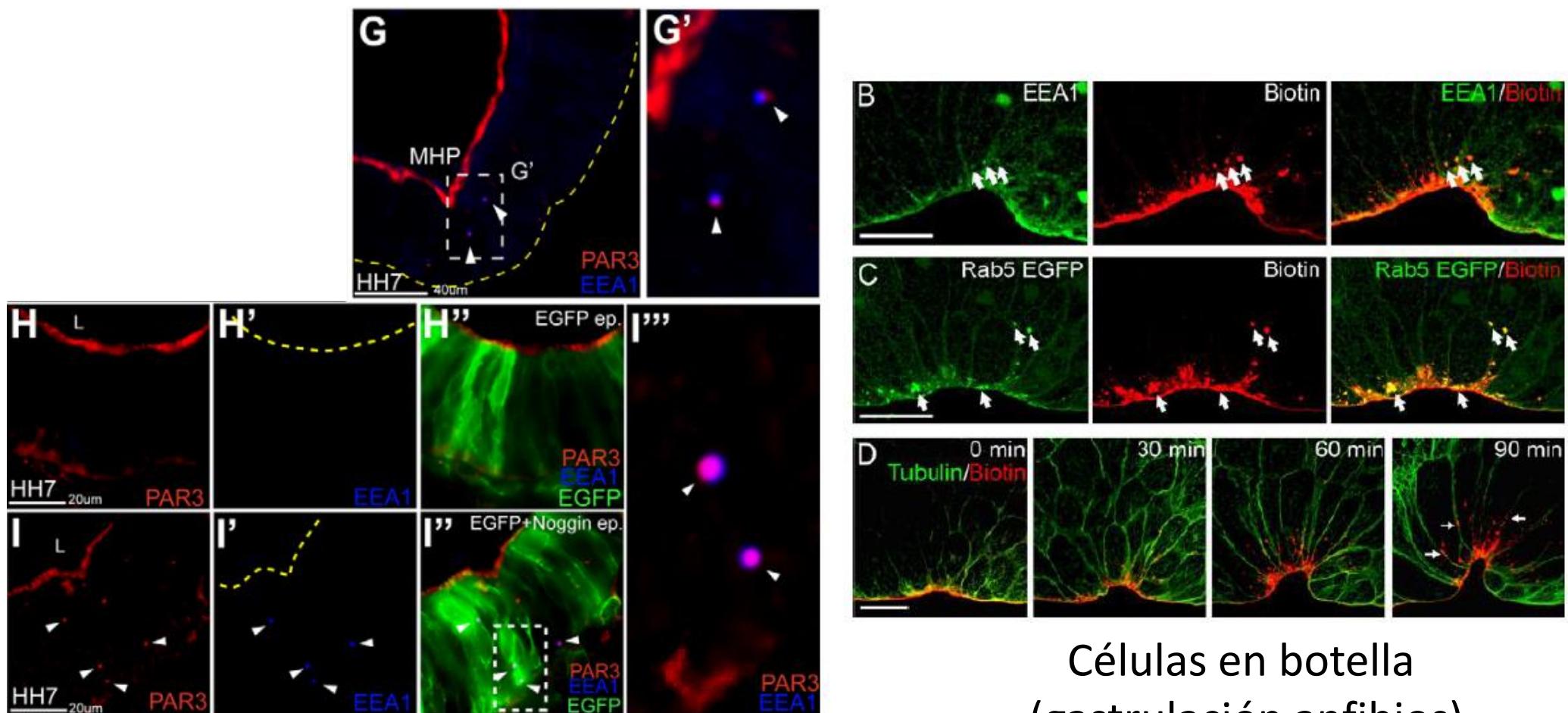


Morfolino



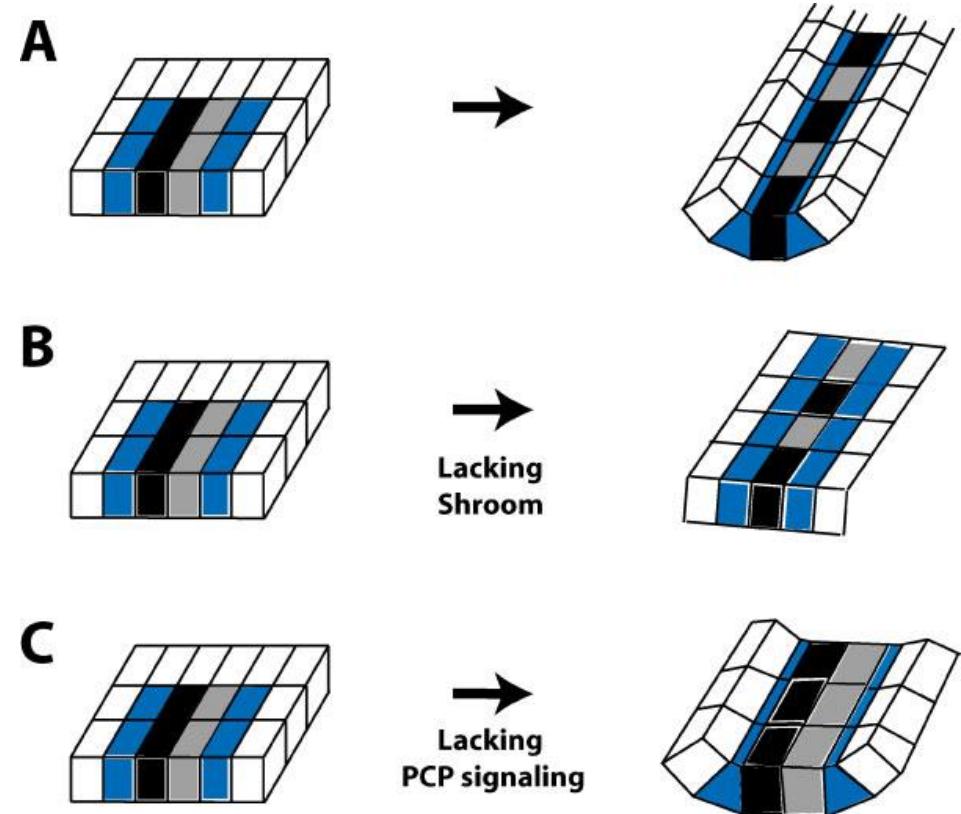
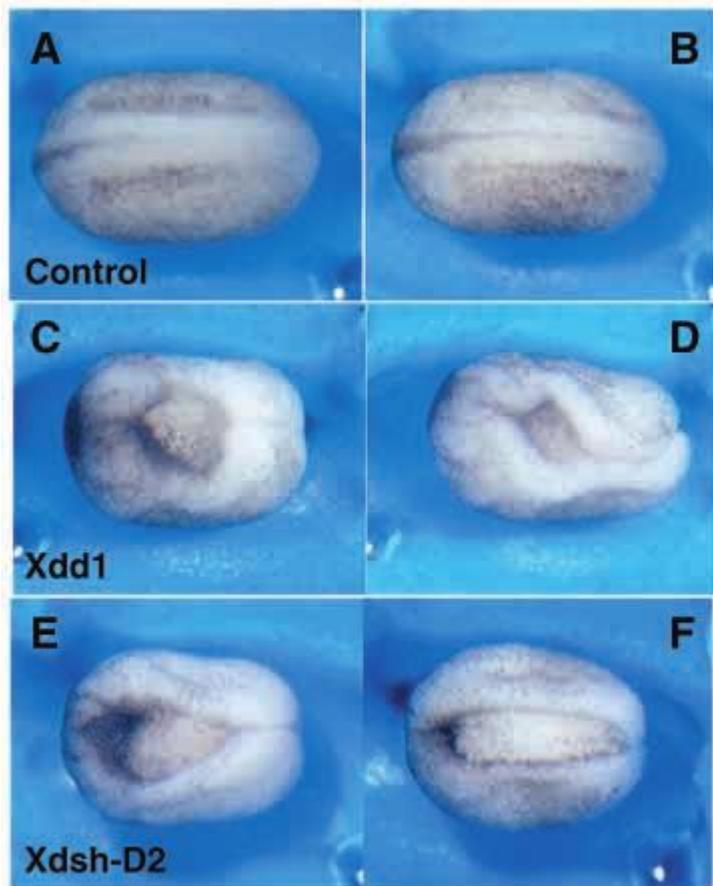
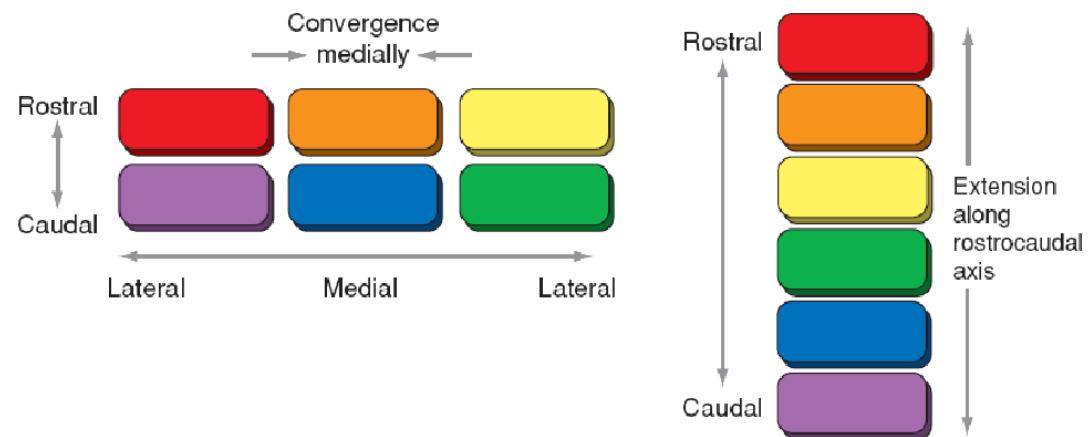
# Bone morphogenetic proteins regulate neural tube closure by interacting with the apicobasal polarity pathway

Dae Seok Eom<sup>1,2,\*</sup>, Smita Amarnath<sup>2</sup>, Jennifer L. Fogel<sup>3,†</sup> and Seema Agarwala<sup>1,2,3,‡</sup>



Células en botella  
(gastrulación anfibios)

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



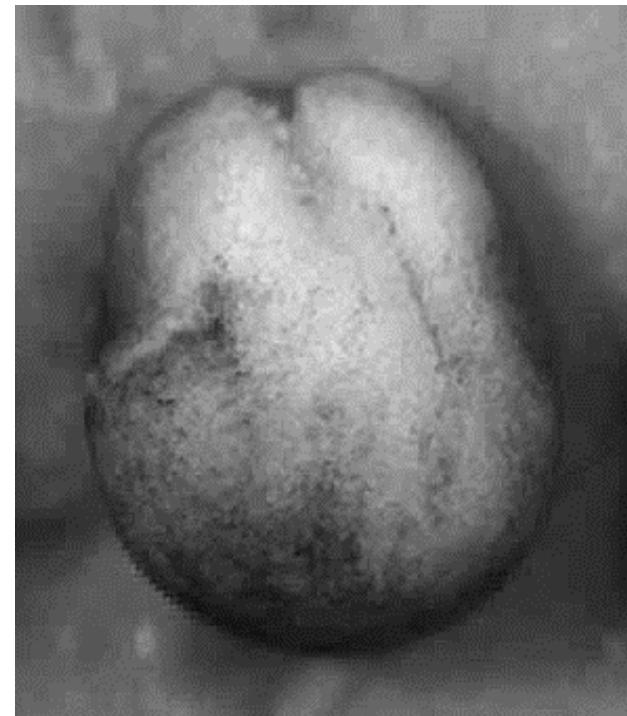
## Neural tube closure requires Dishevelled-dependent convergent extension of the midline

John B. Wallingford\* and Richard M. Harland



Control

<https://youtu.be/MzHVHLHnMNO>

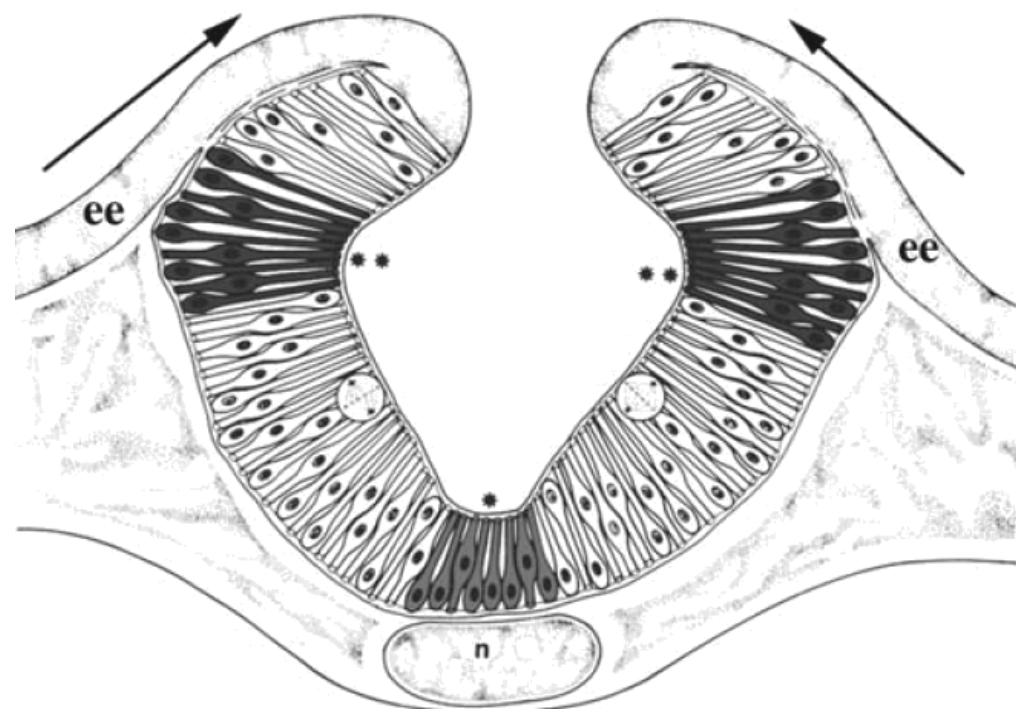


MO Xdsh

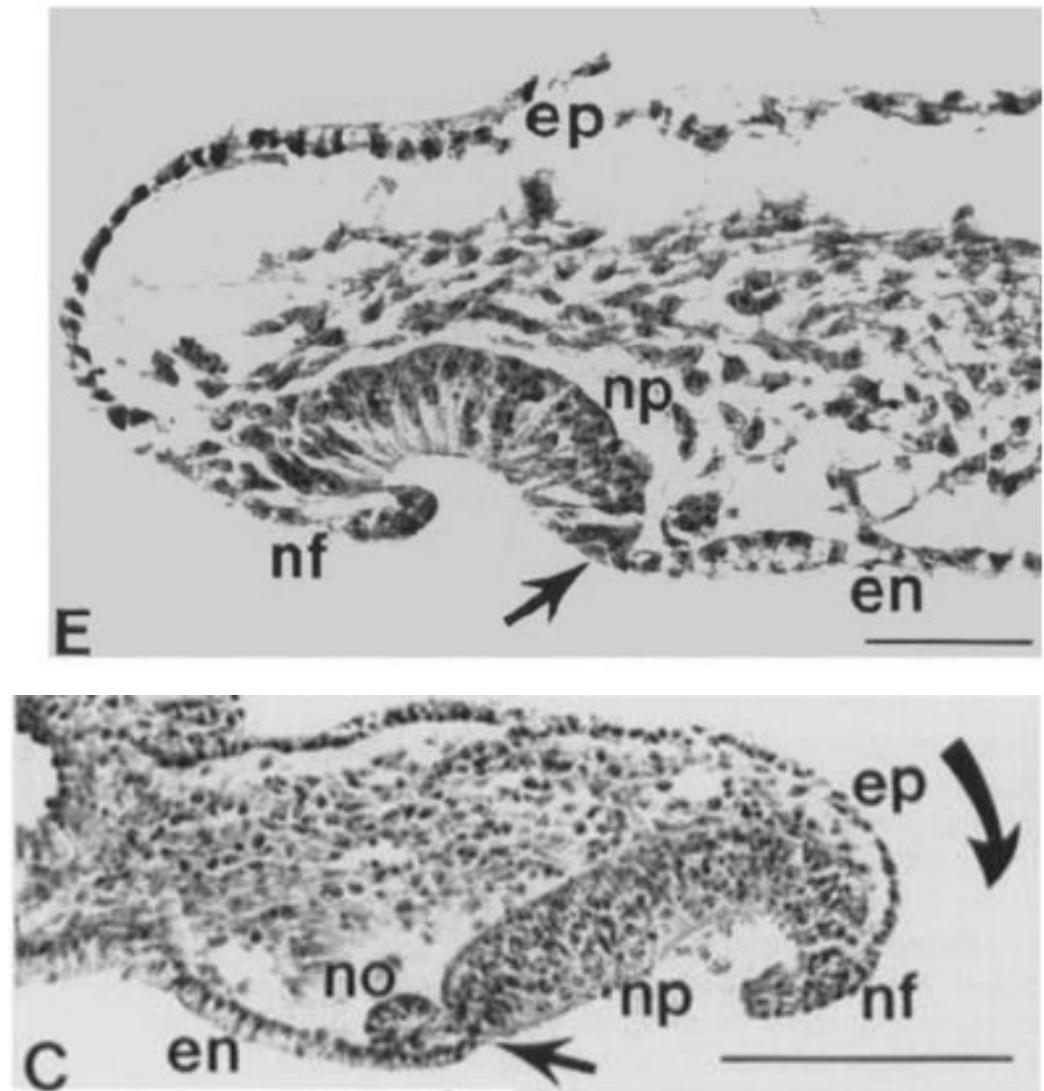
<https://youtu.be/9edjA6jV7Ho>

**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**

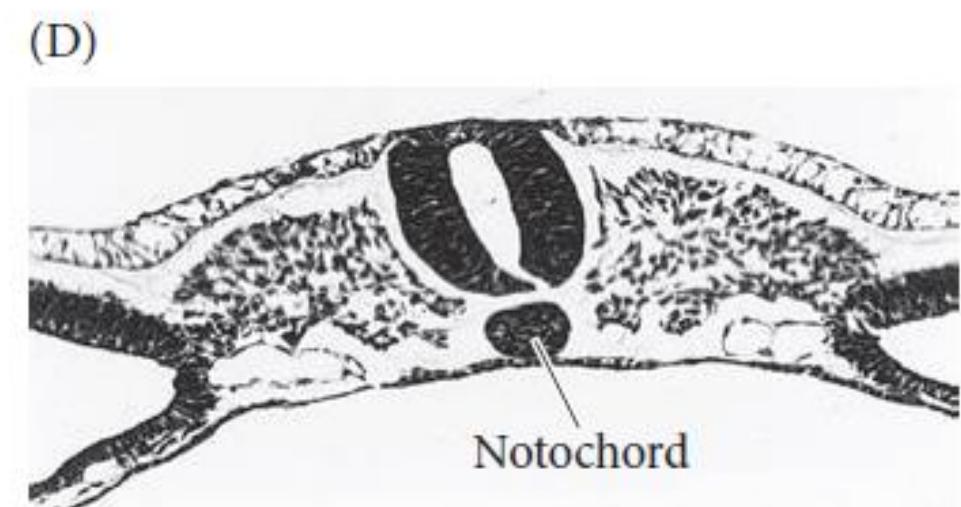
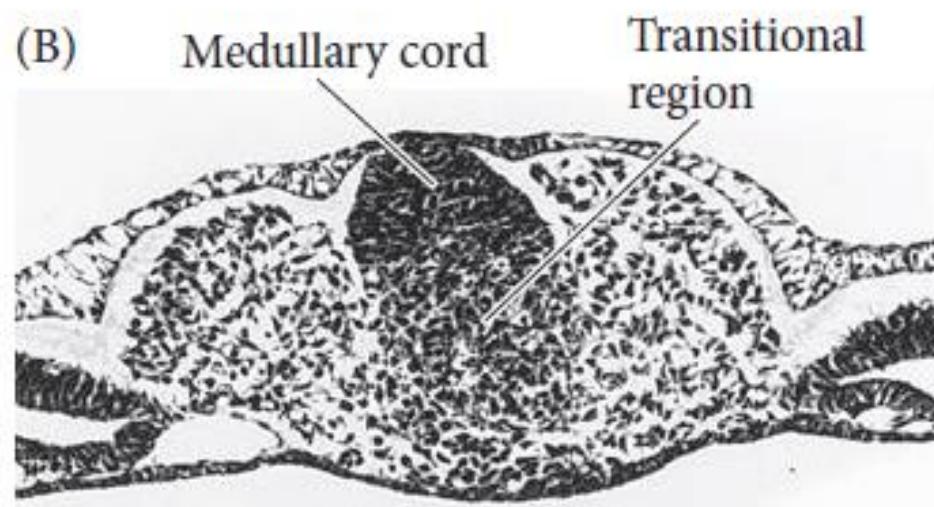
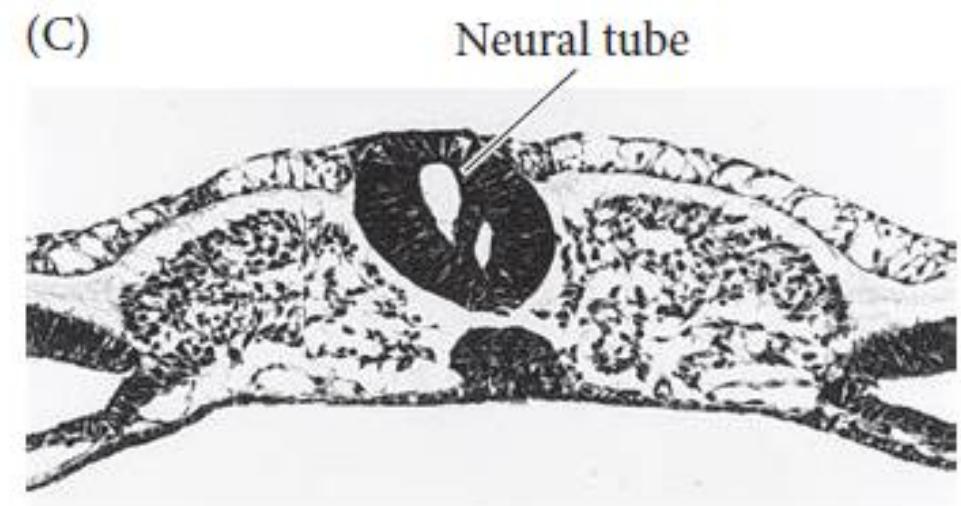
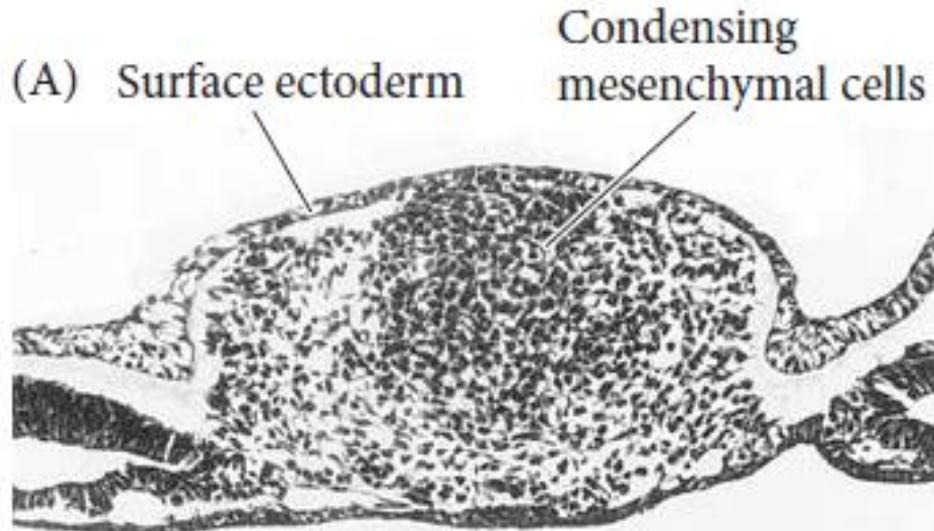
J. DAVID MOURY AND GARY C. SCHOENWOLF



**Fuerzas extrínsecas:  
ectodermo no neural**

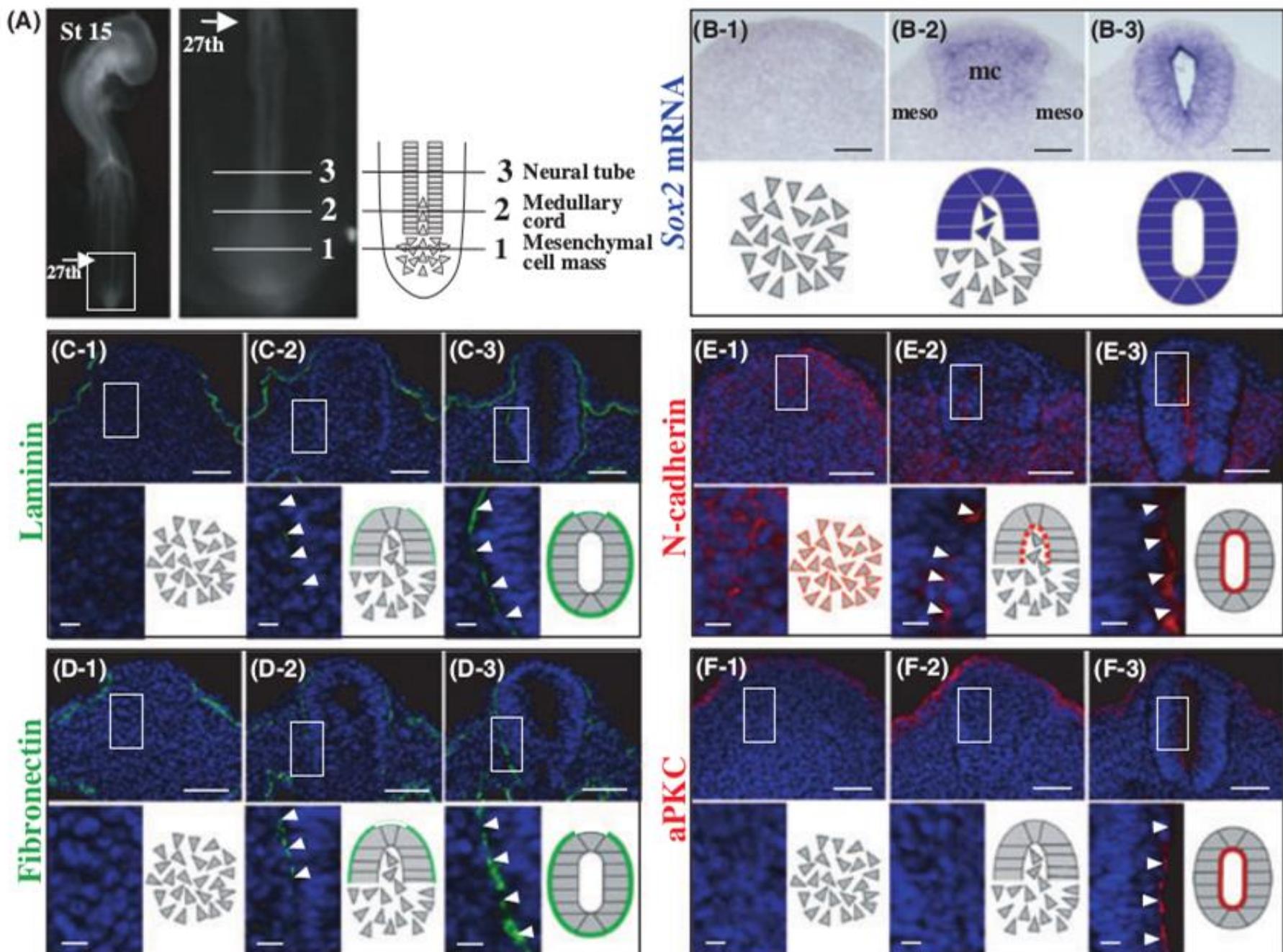


# Cierre del tubo neural: Neurulación secundaria



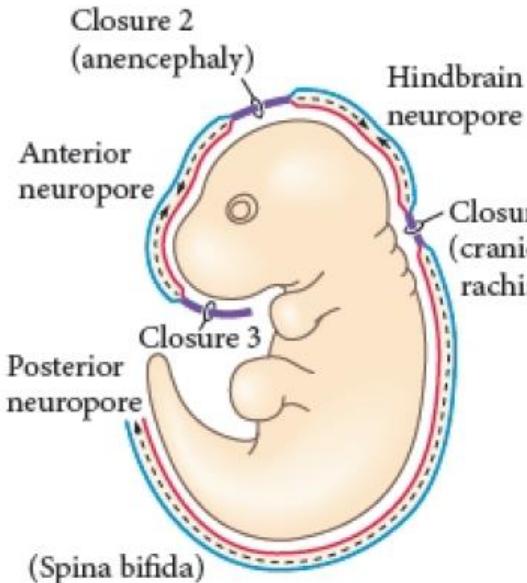
Transición mesénquima-epitelio

# Adquisición de polaridad epitelial

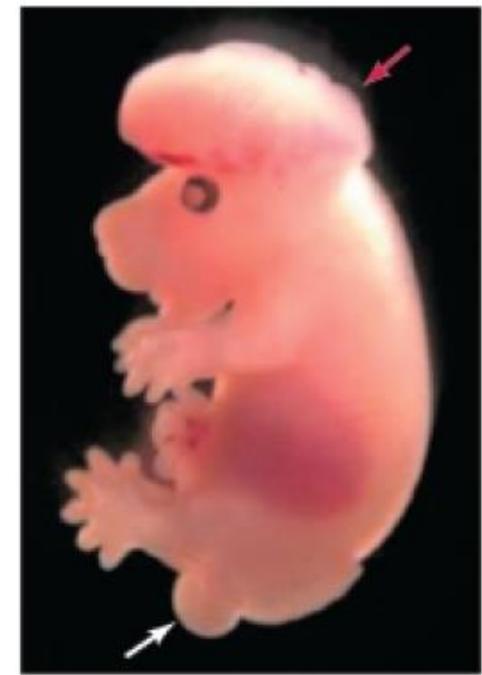
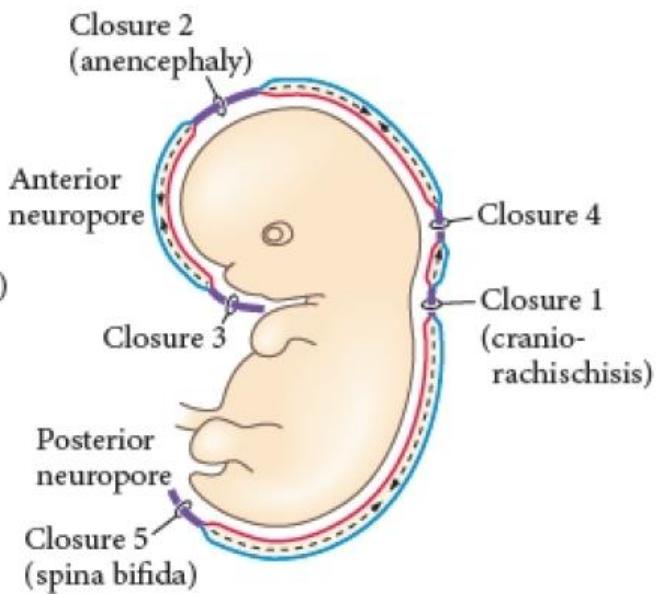


# Cierre del tubo neural en mamíferos

(A) MOUSE

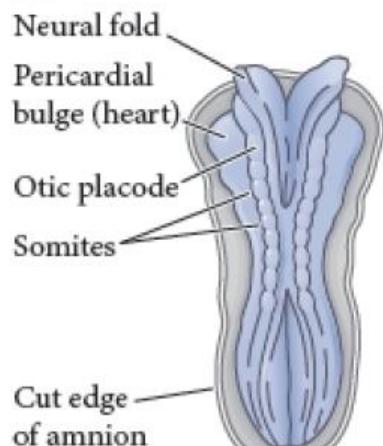


(B) HUMAN



Exencephaly; spina bifida

(C)

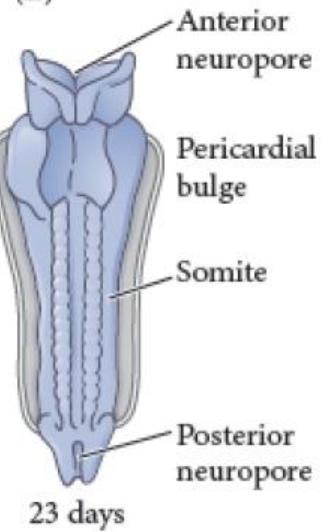


D From T. Nakatsuji et al. 2000.  
*Anat Embryol* 201: 455-466

(D)

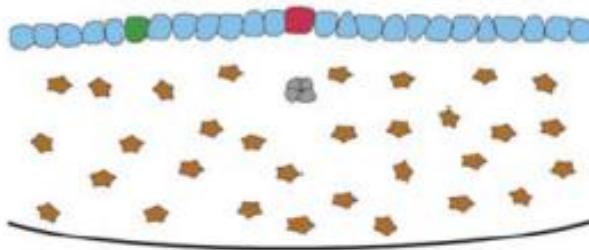


(E)

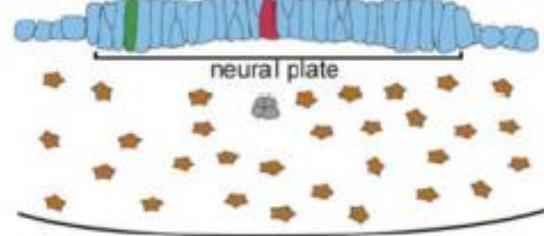


# Neurulación en peces

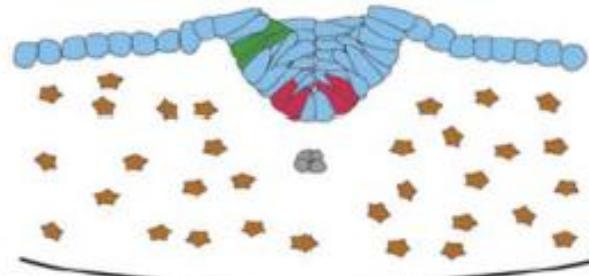
1. Initial epithelium



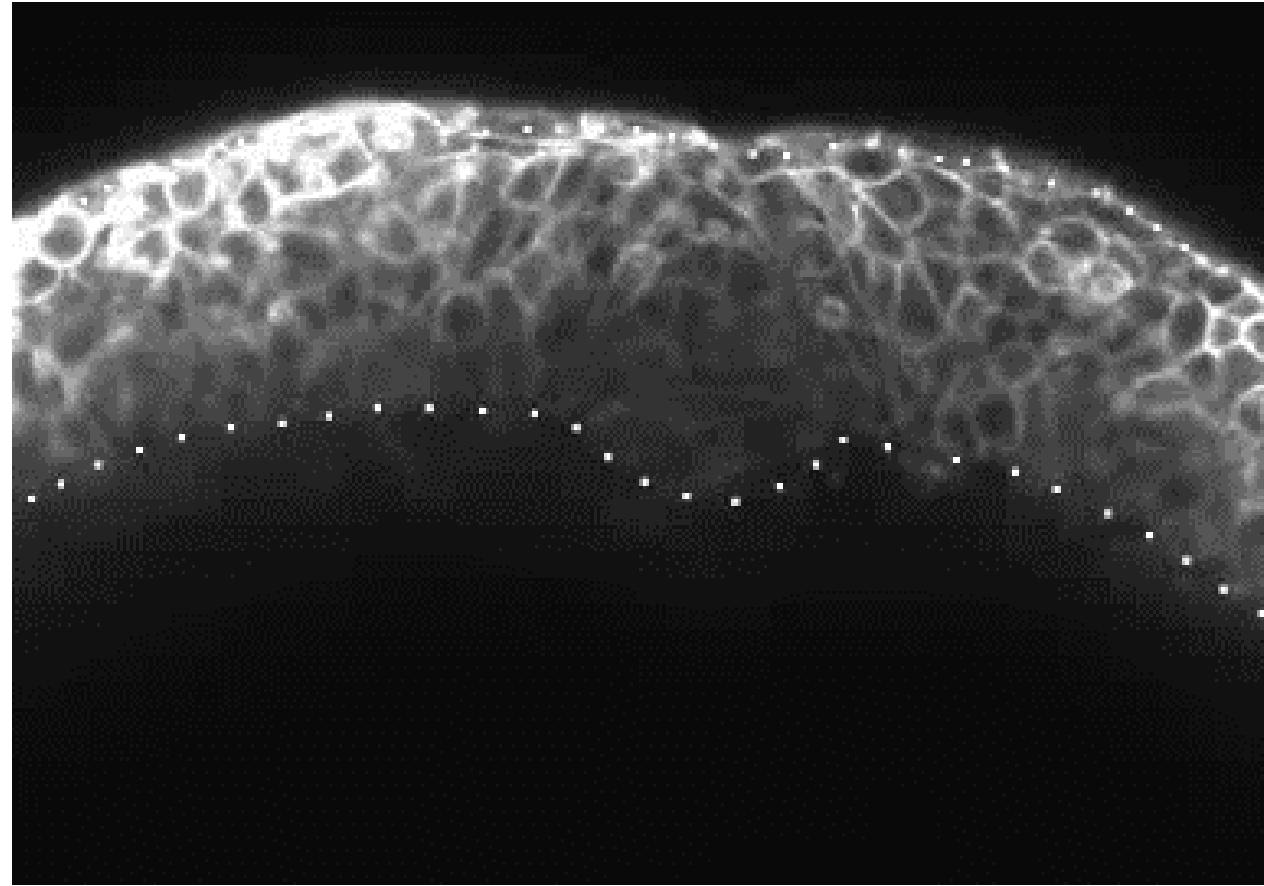
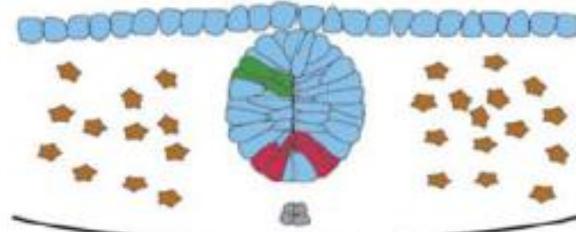
2. Columnarization



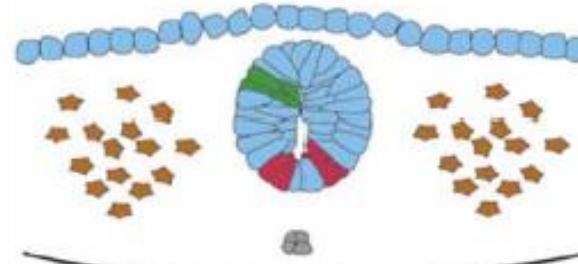
3. Neural keel formation



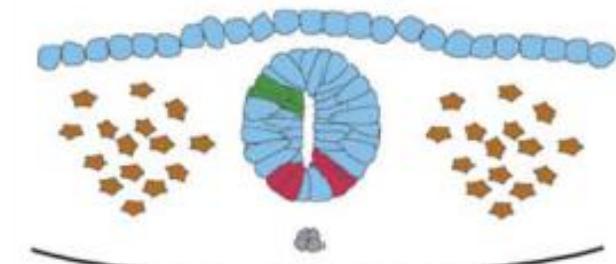
4. Neural rod formation



5. Lumen opening

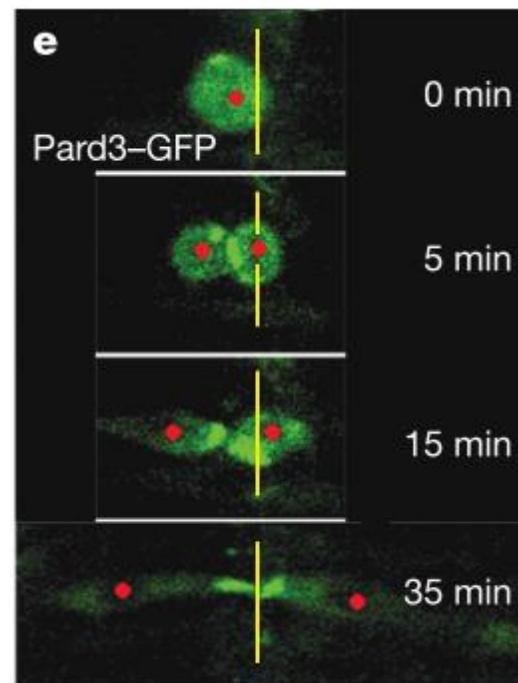
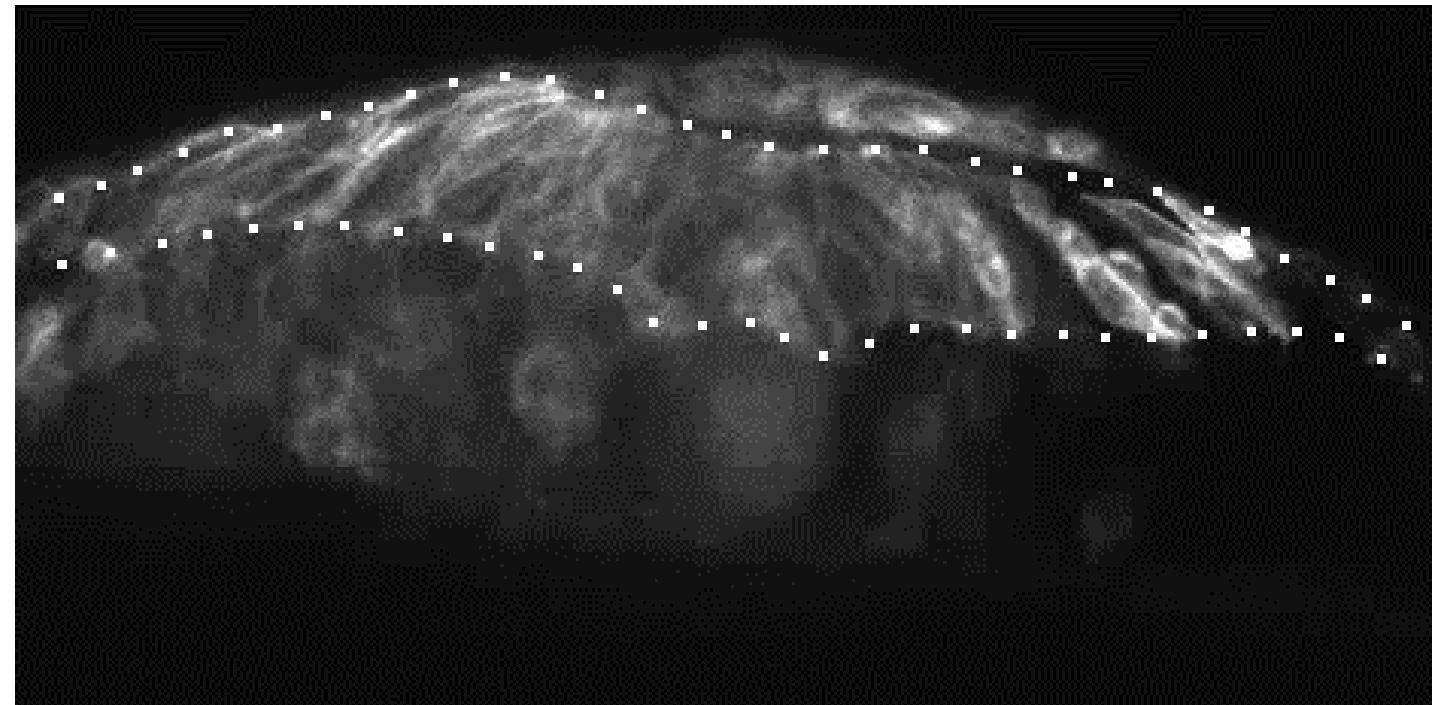


6. Neural tube complete

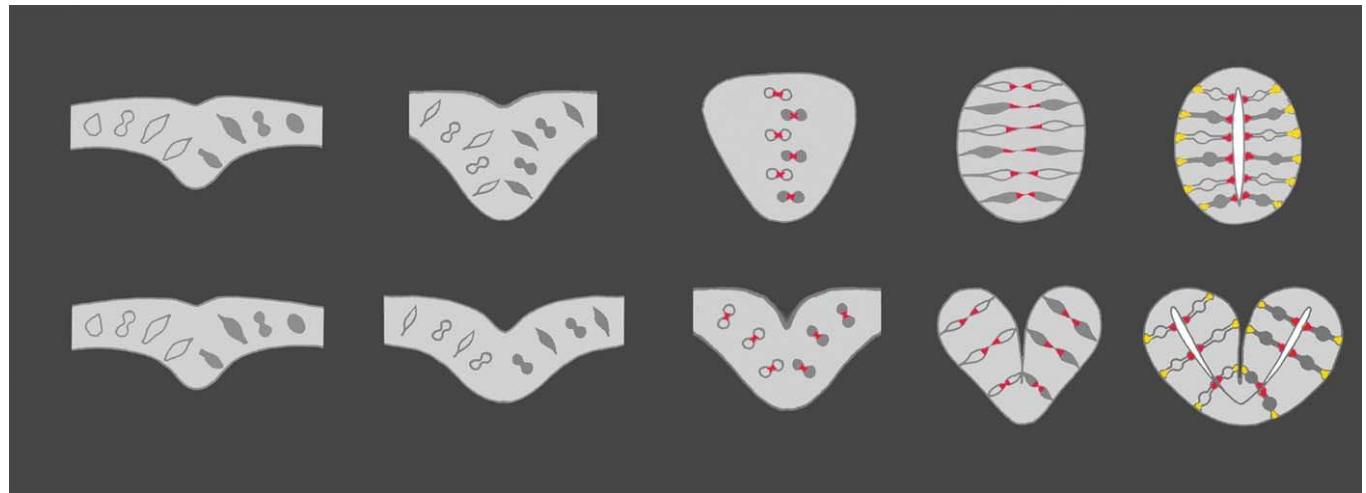


# A mirror-symmetric cell division that orchestrates neuroepithelial morphogenesis

Marcel Tawk<sup>1</sup>, Claudio Araya<sup>1</sup>, Dave A. Lyons<sup>1†</sup>, Alexander M. Reugels<sup>2</sup>, Gemma C. Girdler<sup>1</sup>, Philippa R. Bayley<sup>1†</sup>, David R. Hyde<sup>3</sup>, Masazumi Tada<sup>1</sup> & Jonathan D. W. Clarke<sup>1</sup>

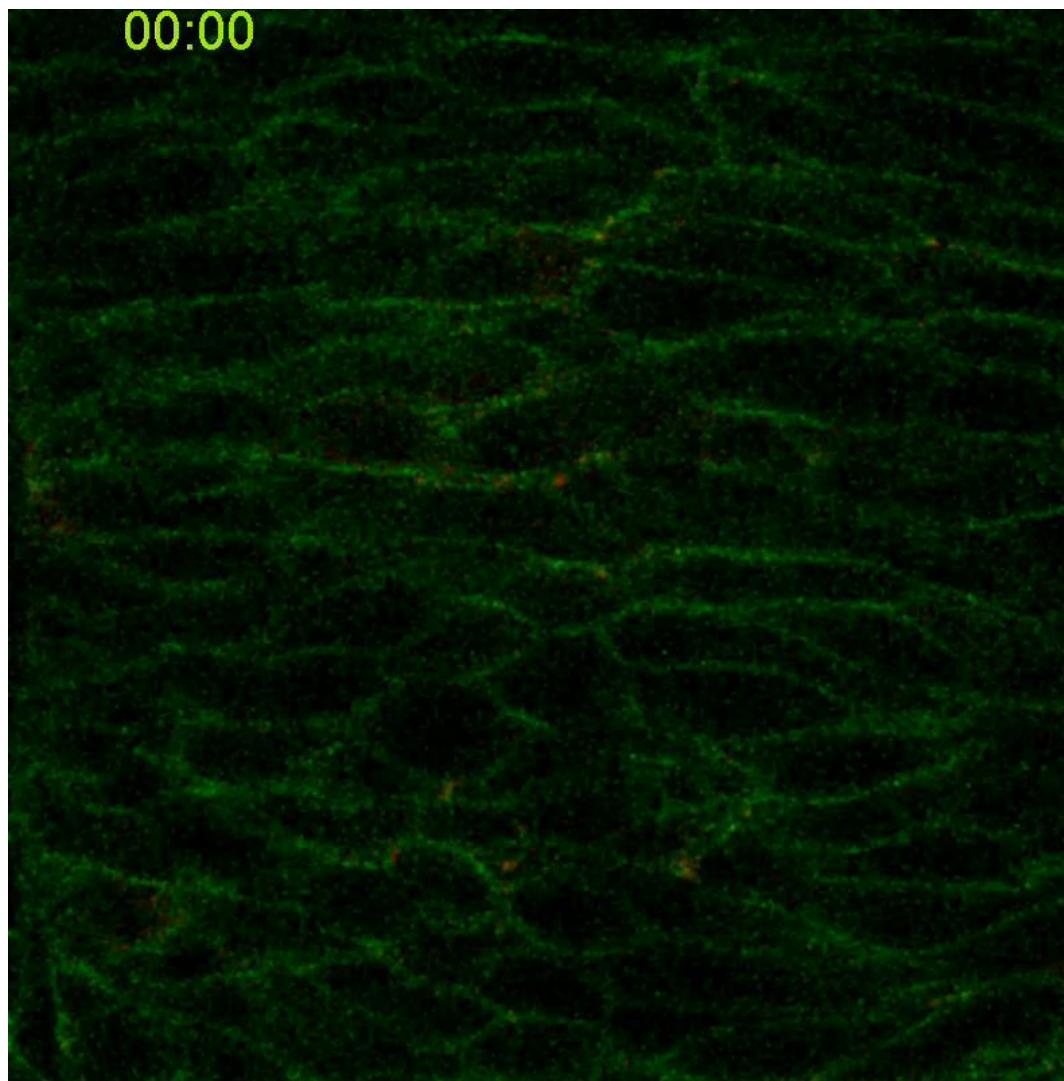


<https://www.nature.com/articles/nature05722#supplementary-information>



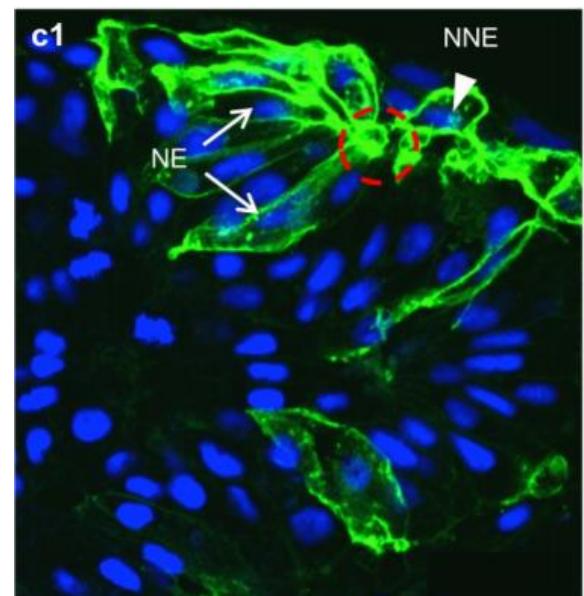
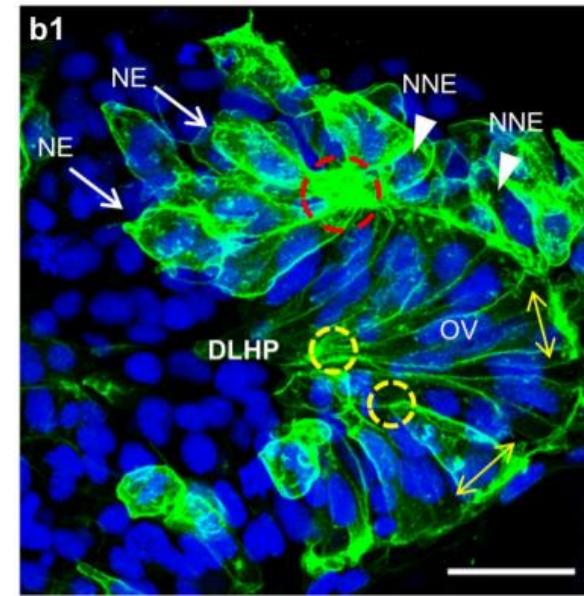
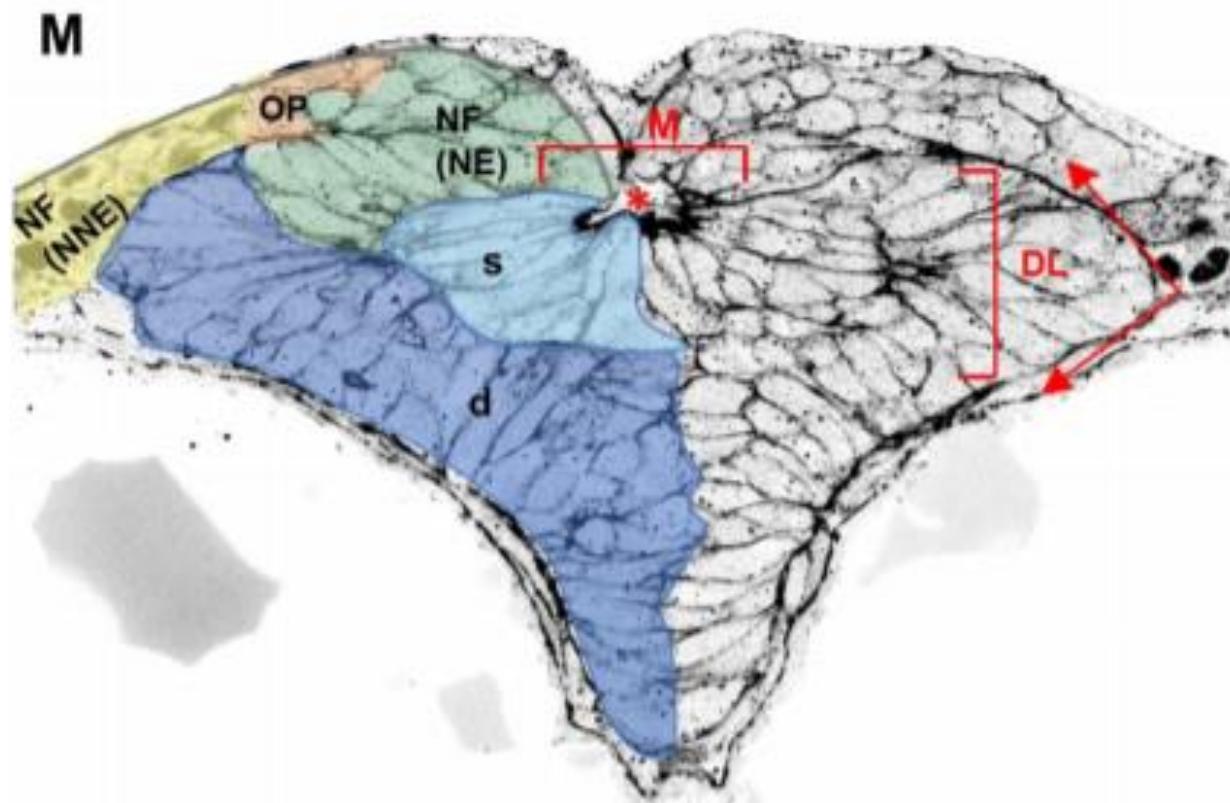
# Apical Cell-Cell Adhesions Reconcile Symmetry and Asymmetry in Zebrafish Neurulation

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

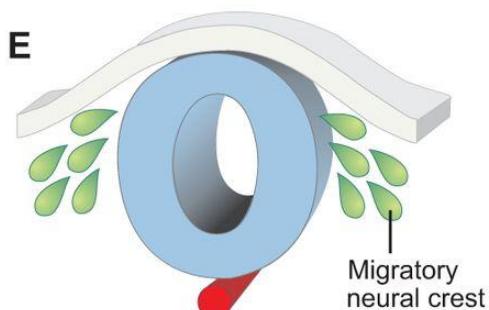
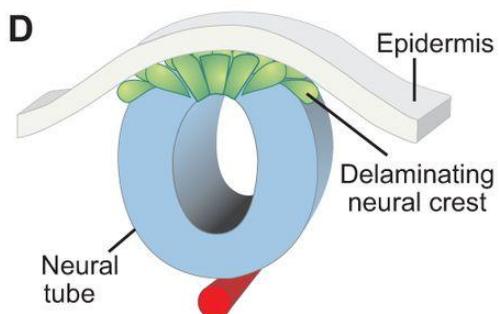
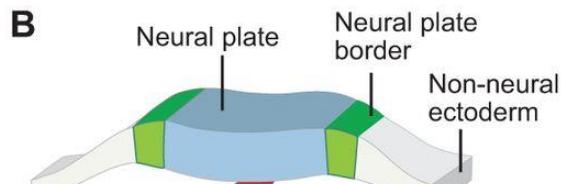
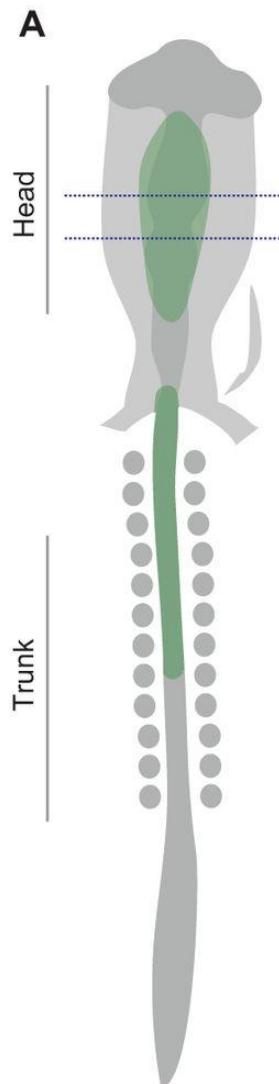


# Hallmarks of primary neurulation are conserved in the zebrafish forebrain

Jonathan M. Werner<sup>1,2</sup>, Maraki Y. Negesse<sup>1,2</sup>, Dominique L. Brooks<sup>1</sup>, Allyson R. Caldwell<sup>1</sup>, Jafira M. Johnson<sup>1</sup> & Rachel M. Brewster<sup>1</sup> <sup>1</sup>



# *La cuarta hoja embrionaria: la cresta neural*



## **F Neural crest derivatives**

### **Mesenchymal cells**

- Chondroblasts/chondrocytes
- Osteoblasts/osteocytes
- Fibroblasts
- Odontoblasts
- Cardiac mesenchyme
- Myoblasts
- Adipocytes

### **Neuronal cells**

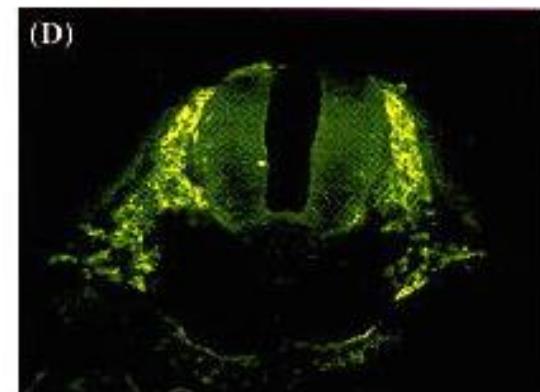
- Sensory neurons
- Cholinergic neurons
- Adrenergic neurons
- Satellite cells
- Schwann cells
- Glial cells

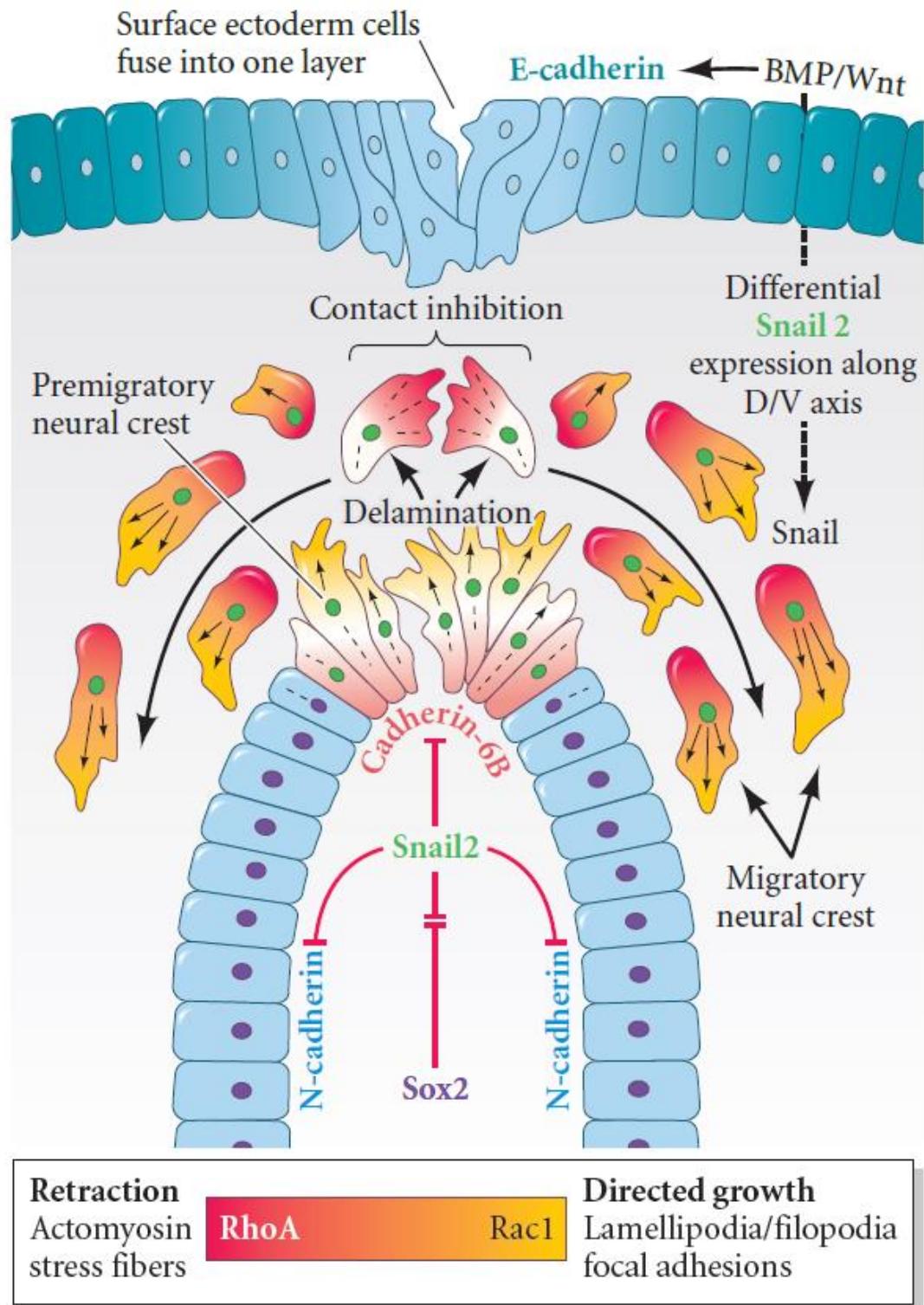
### **Secretory cells**

- Chromaffin cells
- Parafollicular cells
- Calcitonin-producing cells

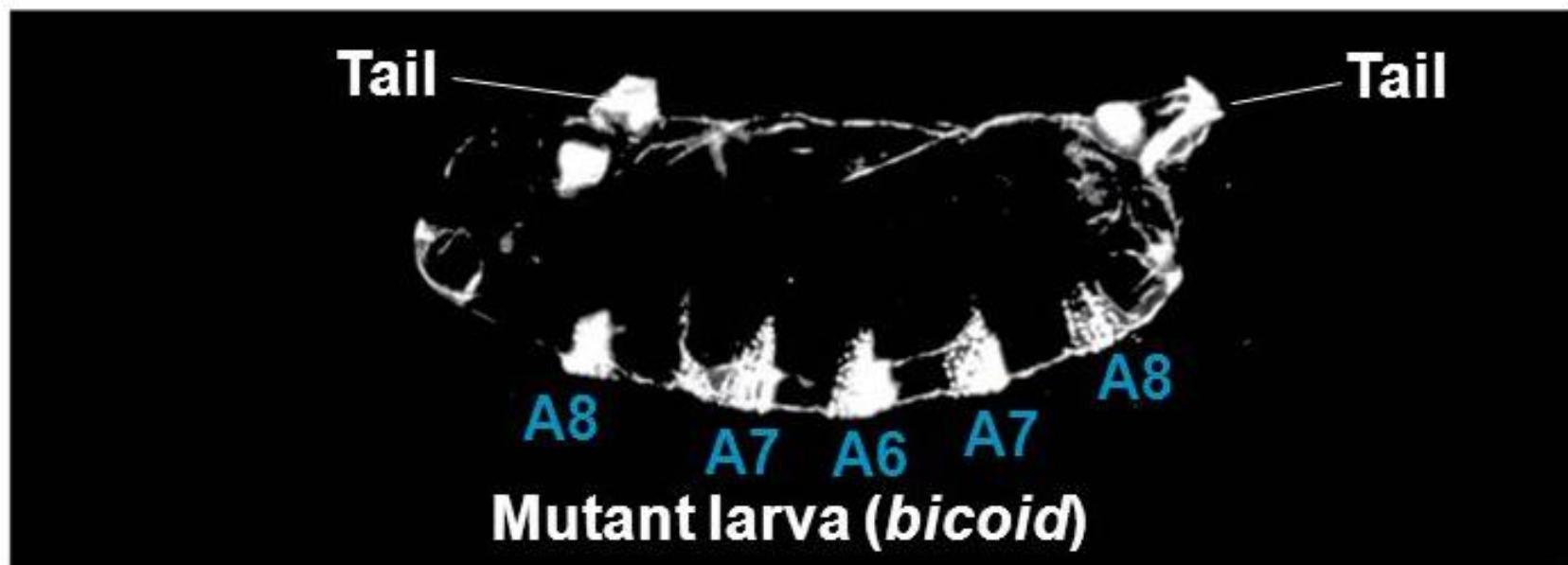
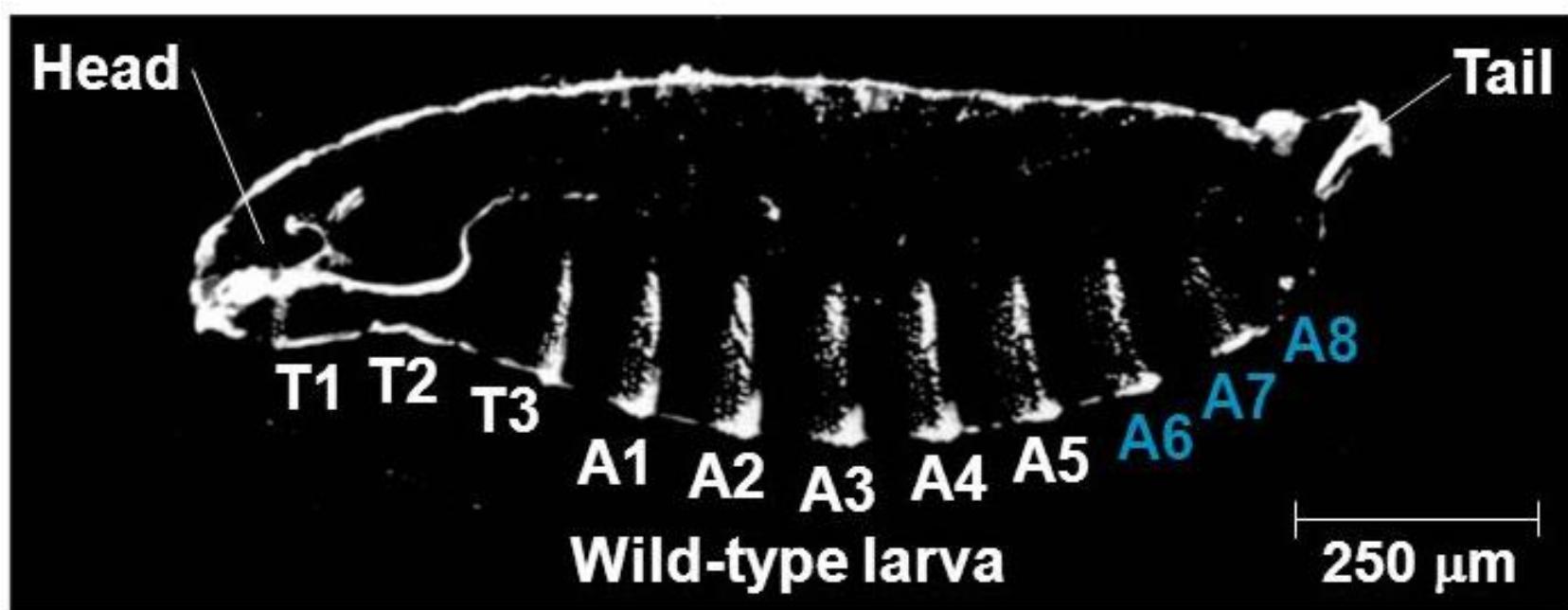
### **Pigmented cells**

- Melanocytes





# Problema:



# The Nobel Prize in Physiology or Medicine 1995



Edward B. Lewis

Prize share: 1/3



Christiane Nüsslein-Volhard

Prize share: 1/3



Eric F. Wieschaus

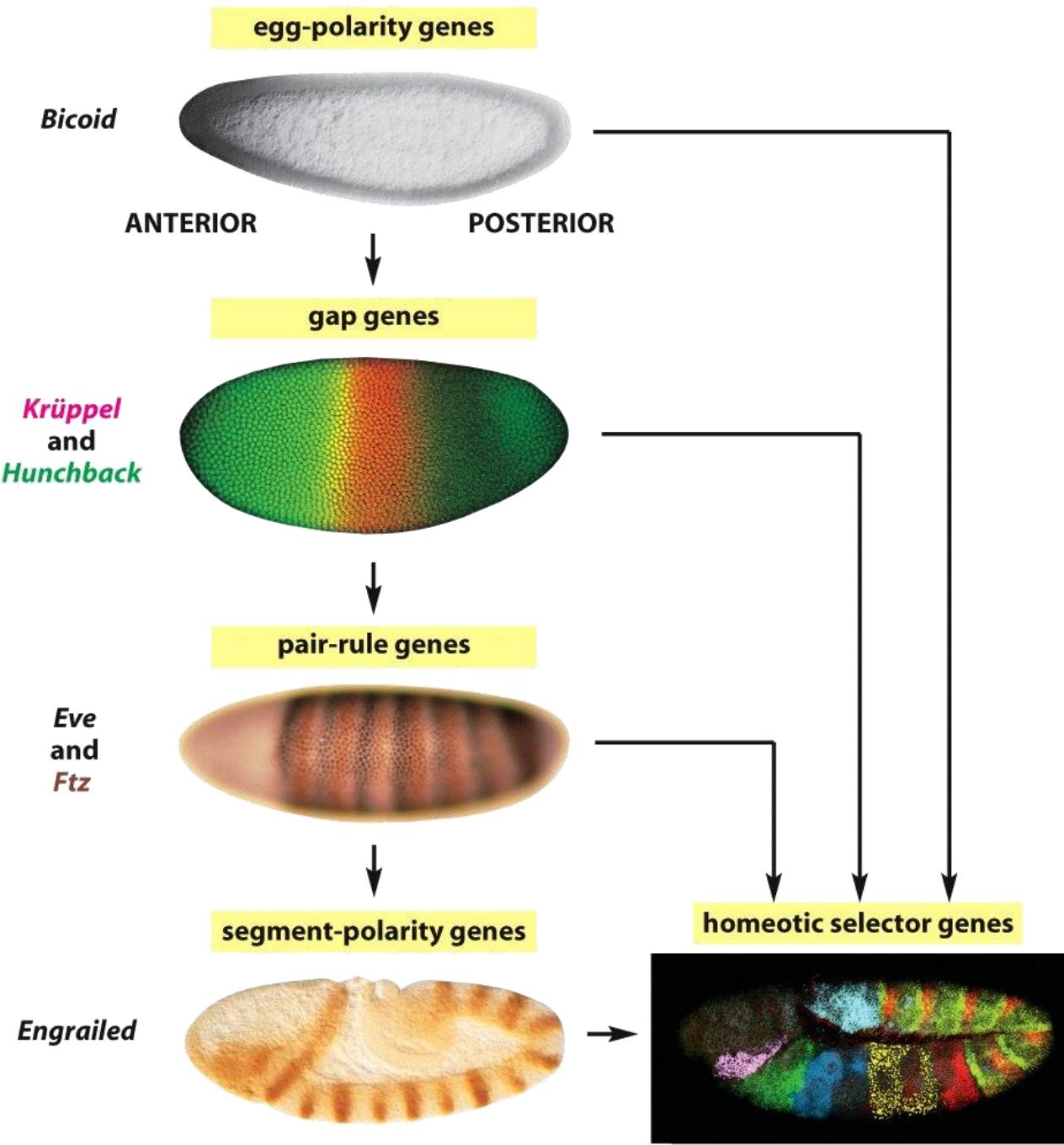
Prize share: 1/3

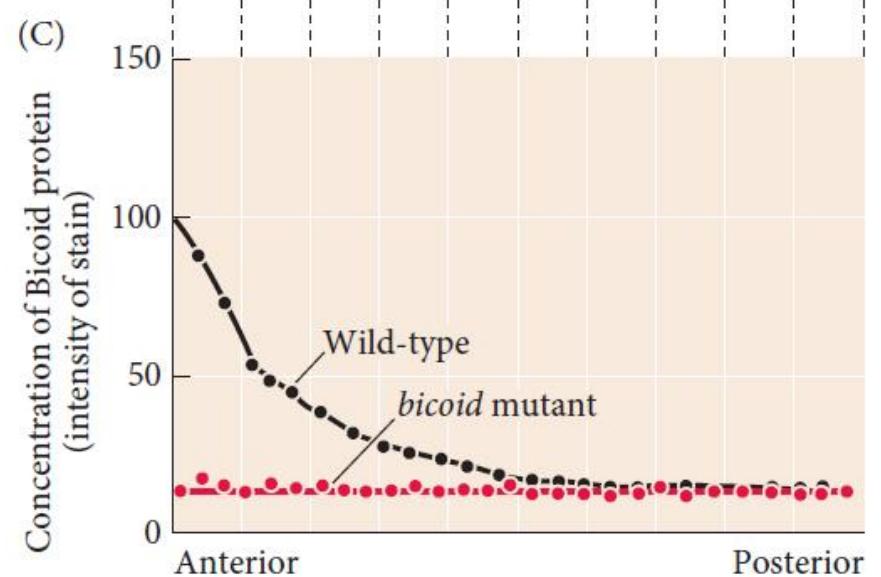
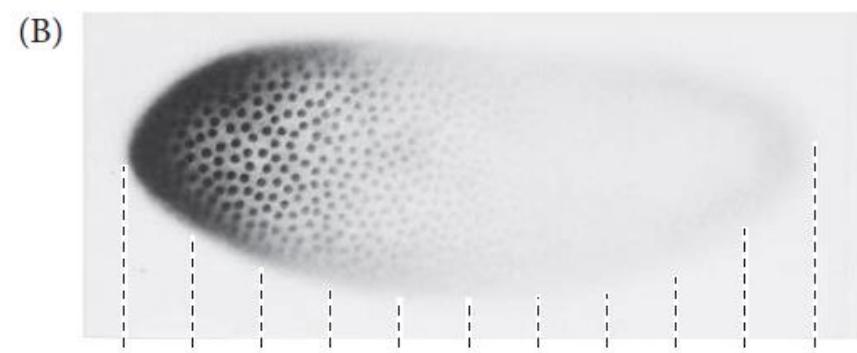
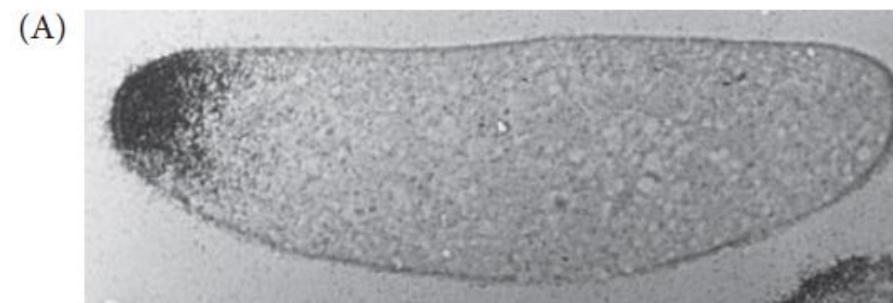
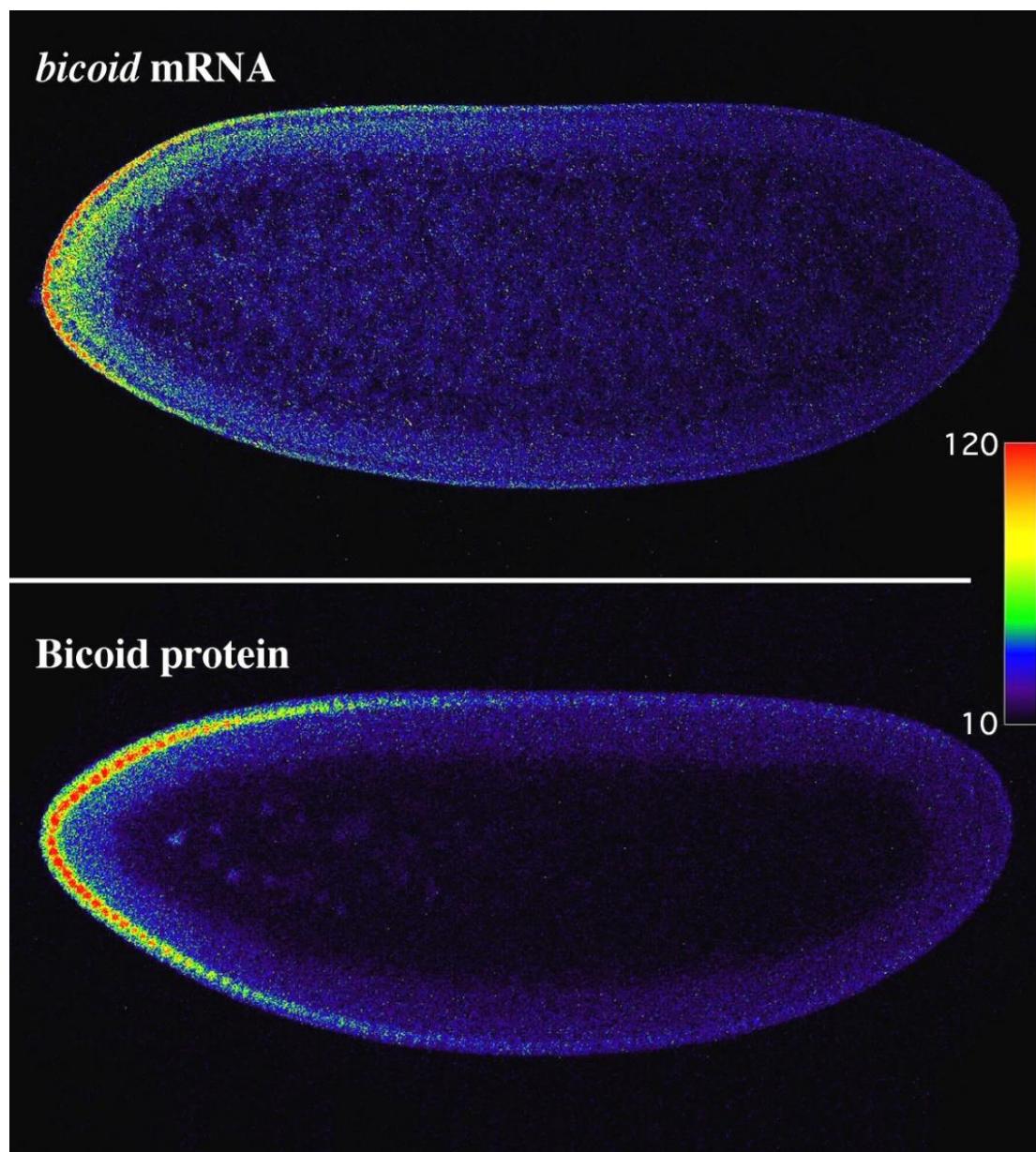
The Nobel Prize in Physiology or Medicine 1995 was awarded jointly to Edward B. Lewis, Christiane Nüsslein-Volhard and Eric F. Wieschaus *"for their discoveries concerning the genetic control of early embryonic development".*

# Clivaje superficial

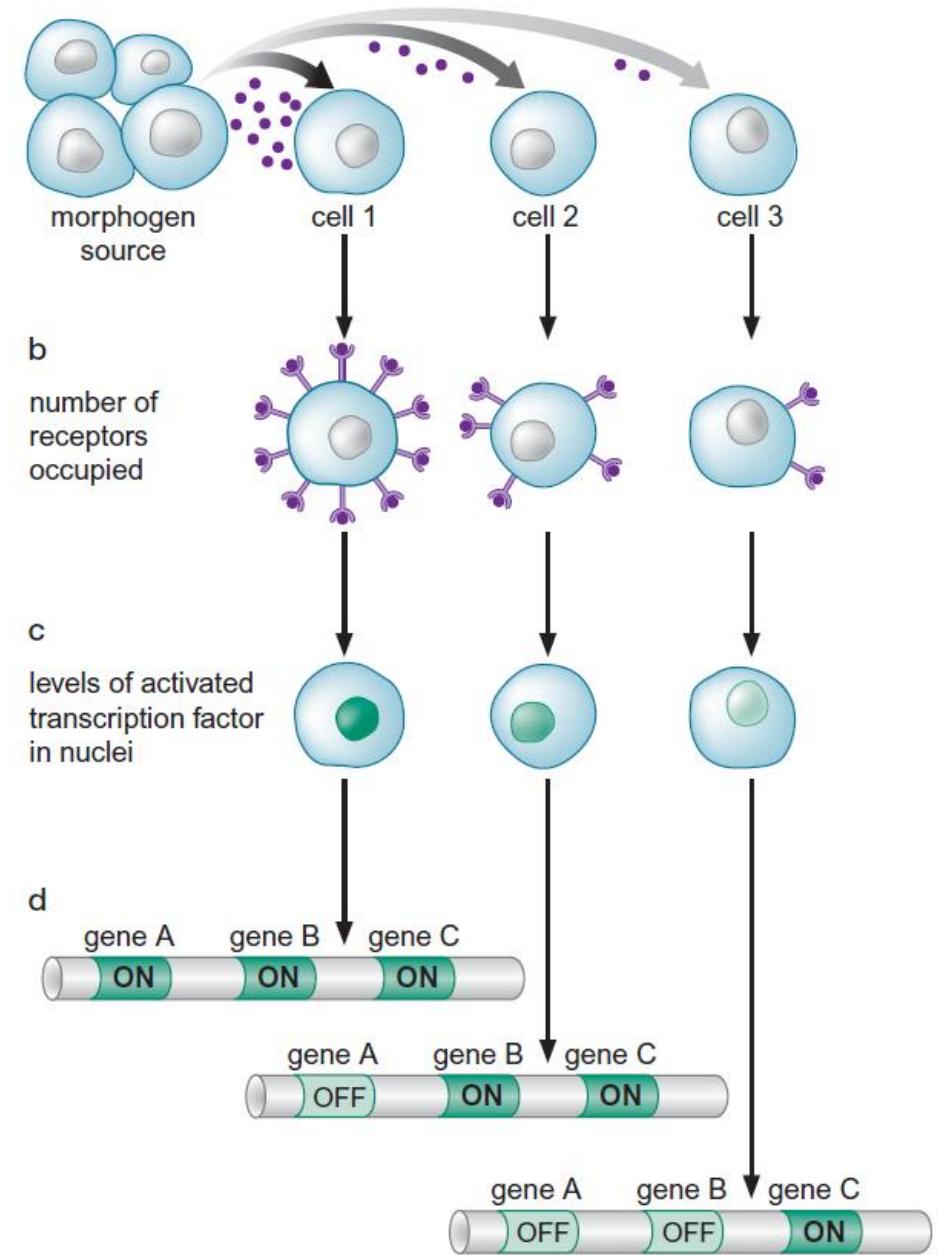
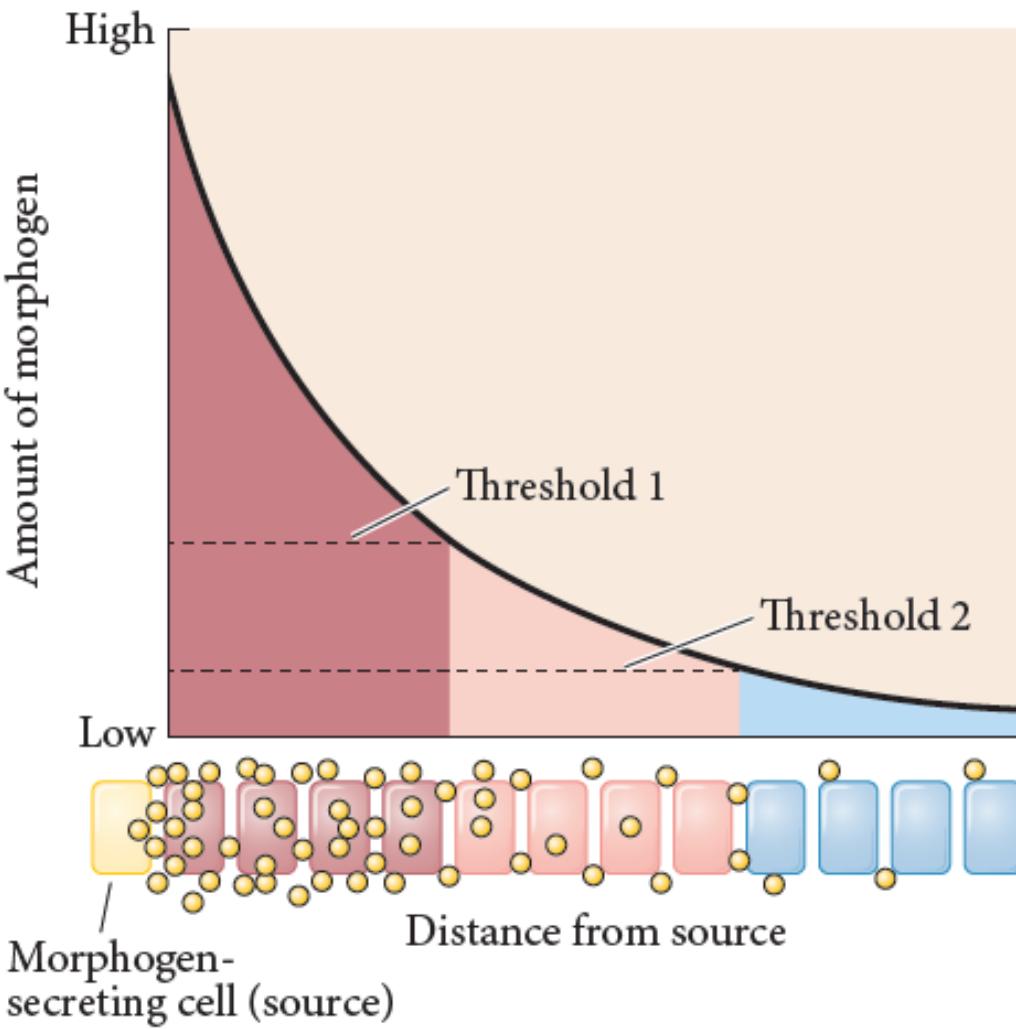


# Definición del eje céfalo-caudal en *Drosophila*



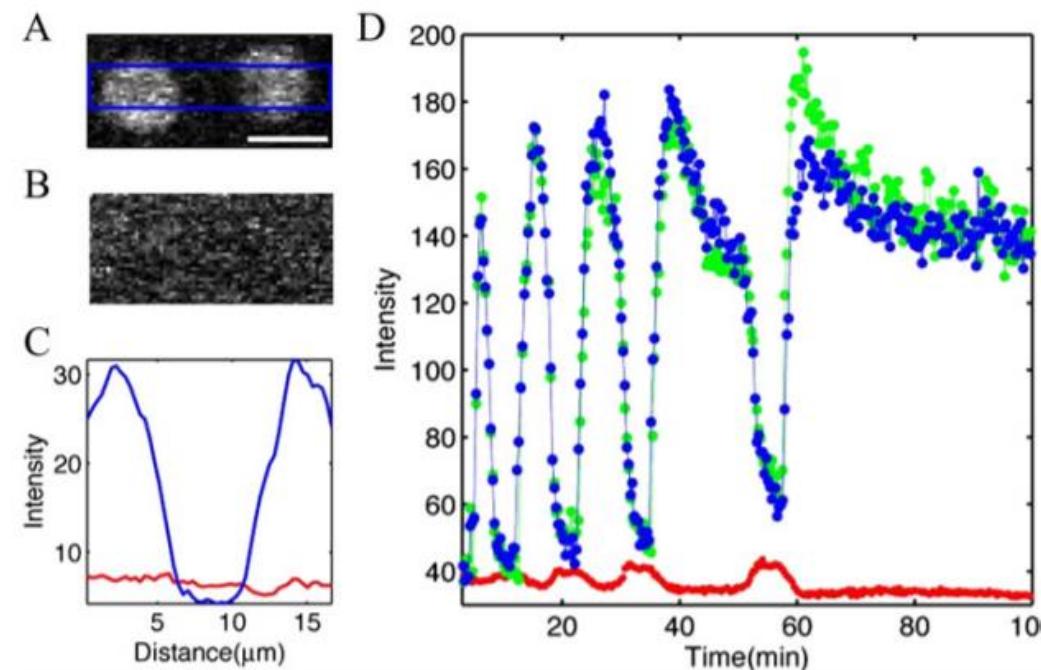


# Información posicional: Morfógenos

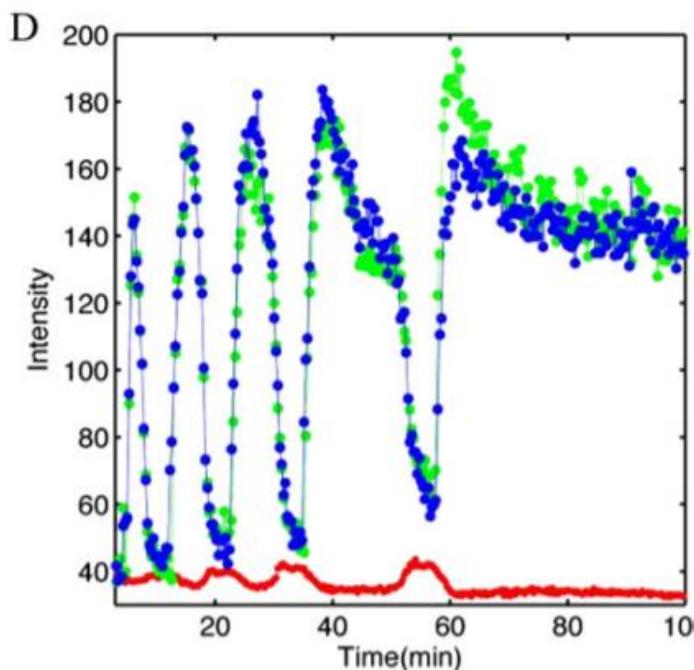
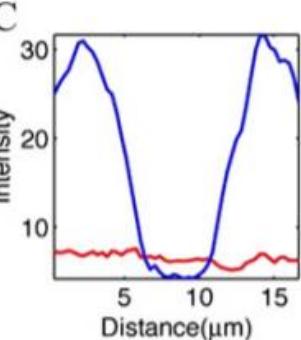


# Stability and Nuclear Dynamics of the Bicoid Morphogen Gradient

Thomas Gregor,<sup>1,2,3,4,\*</sup> Eric F. Wieschaus,<sup>3,4</sup> Alistair P. McGregor,<sup>5</sup> William Bialek,<sup>1,2</sup> and David W. Tank<sup>1,2,3</sup>

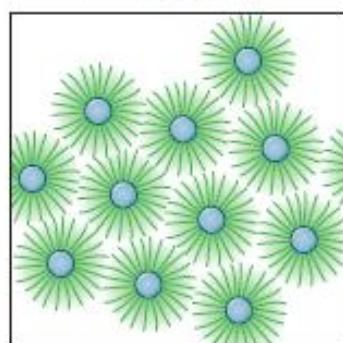
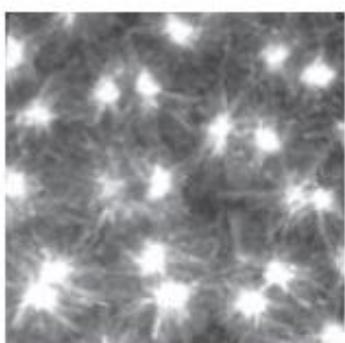


Intensity

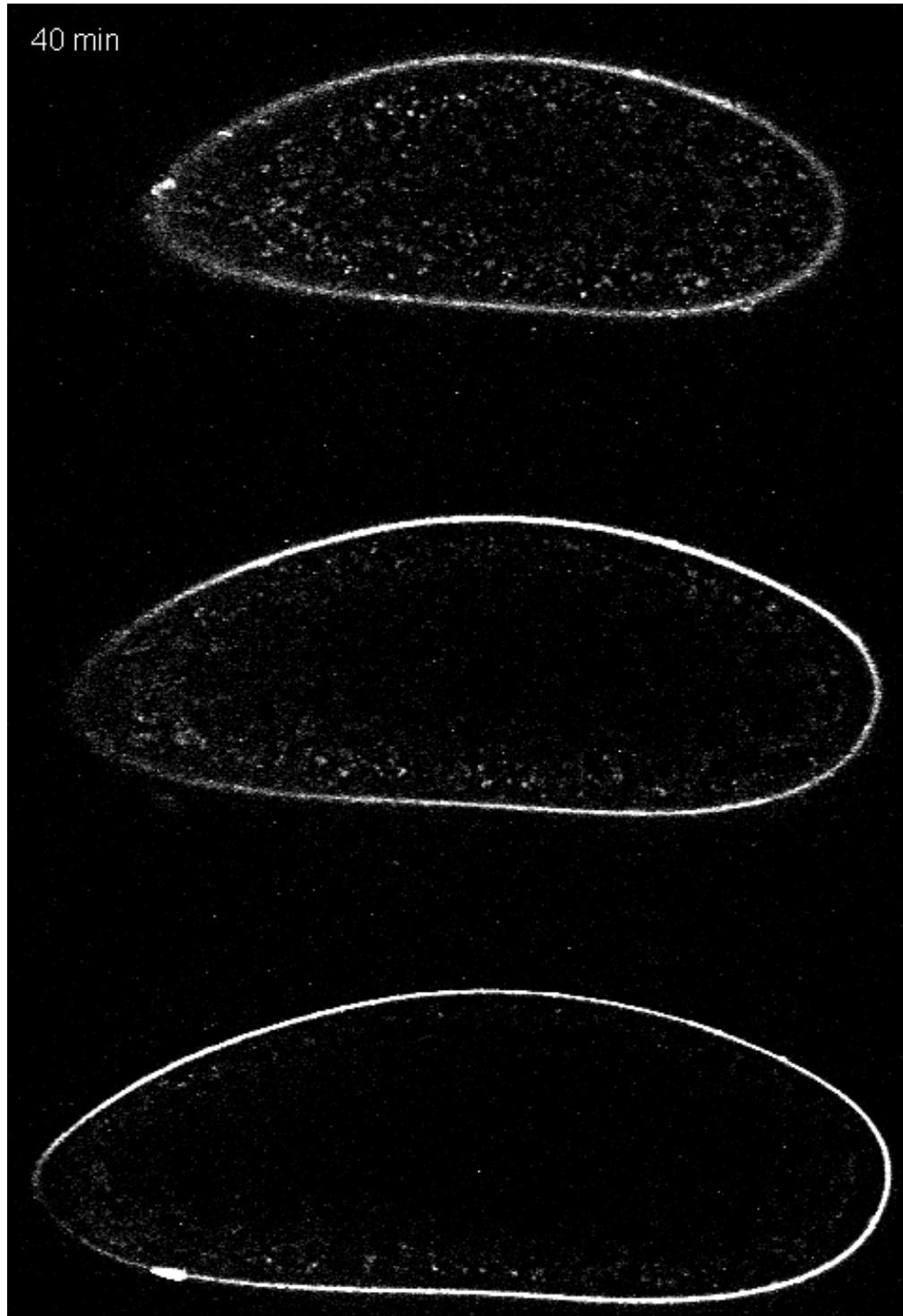


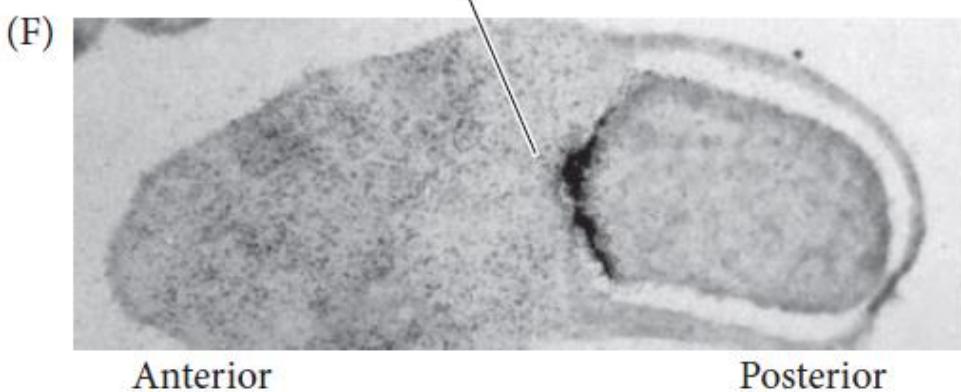
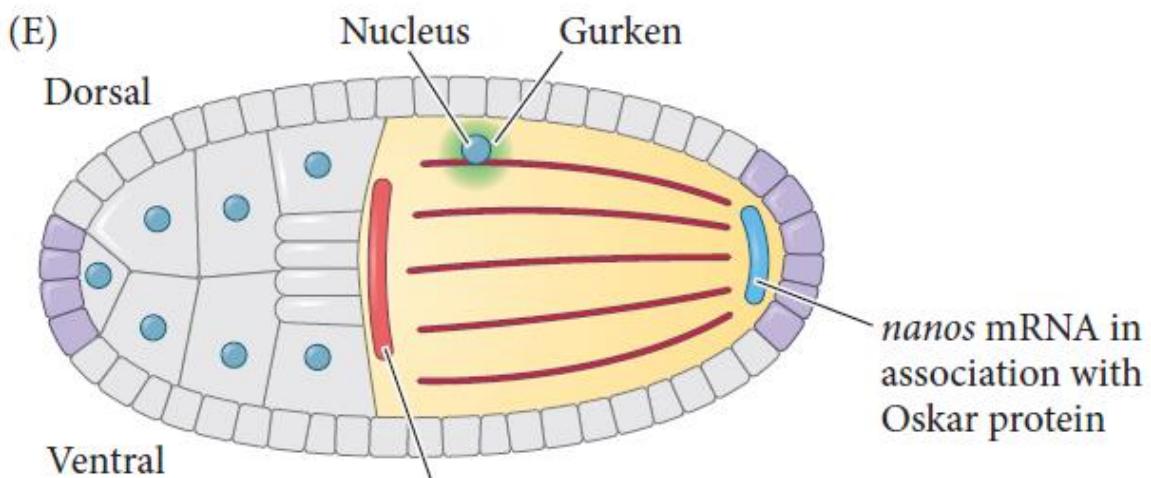
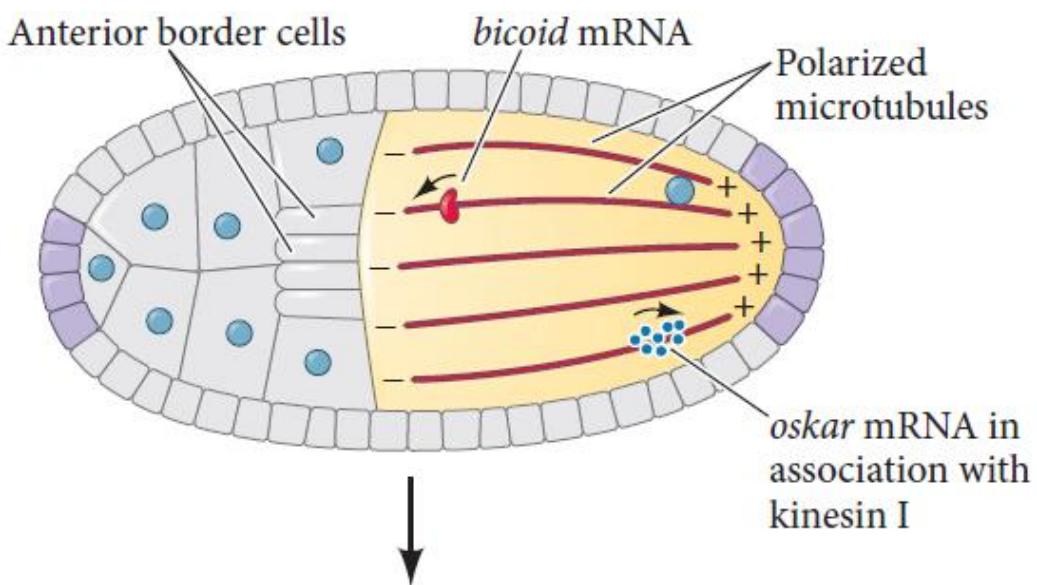
(A)

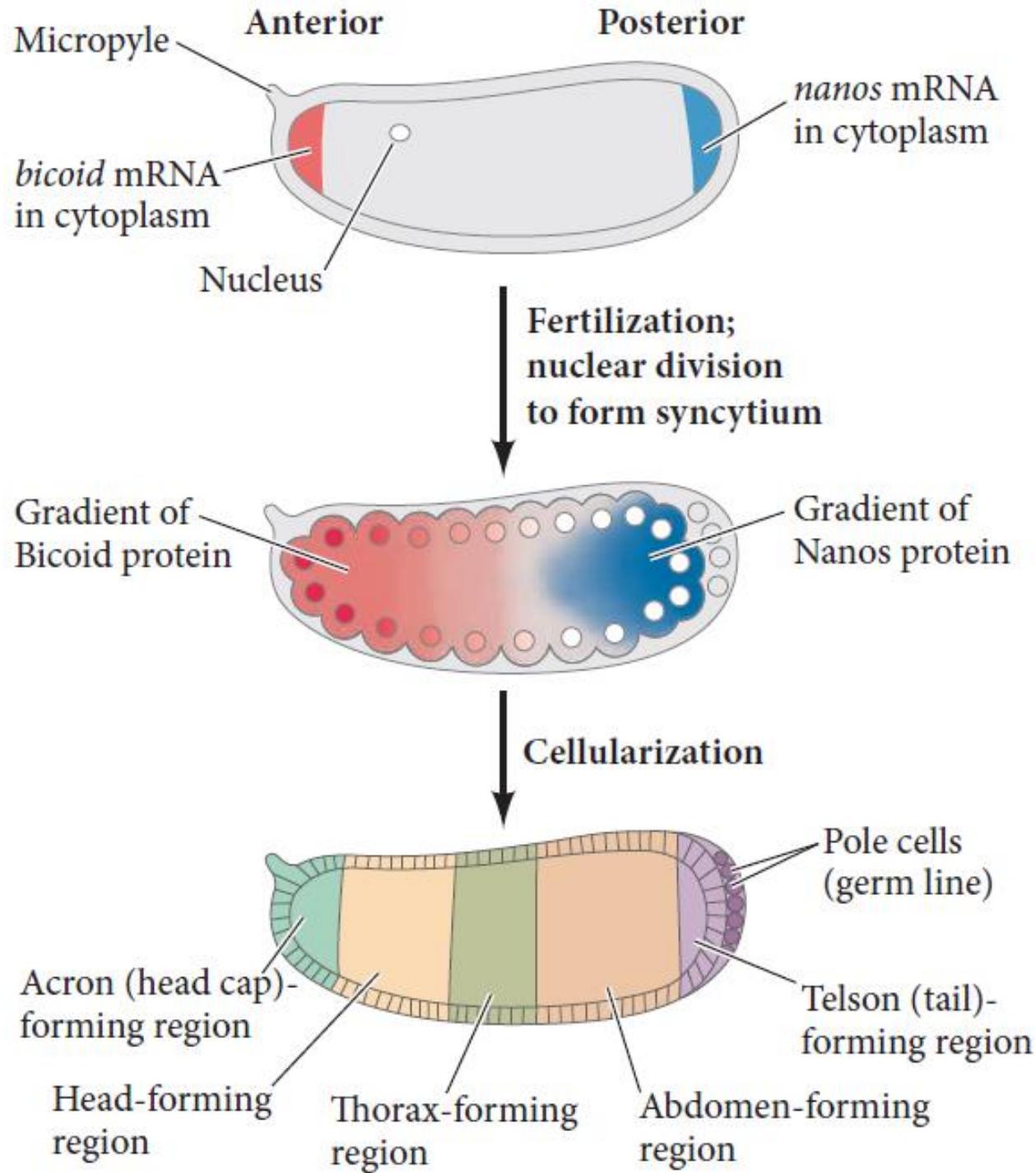
Interphase

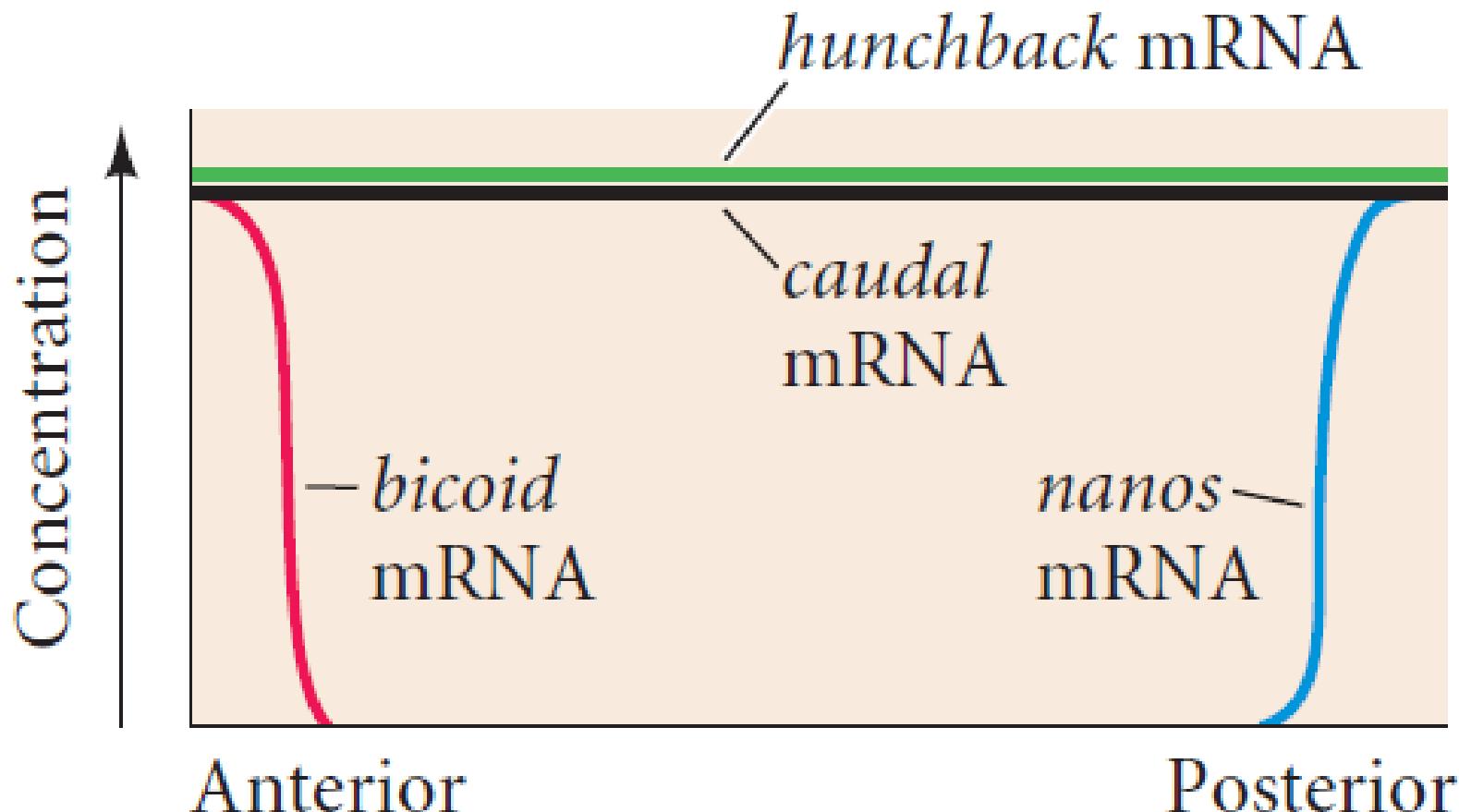


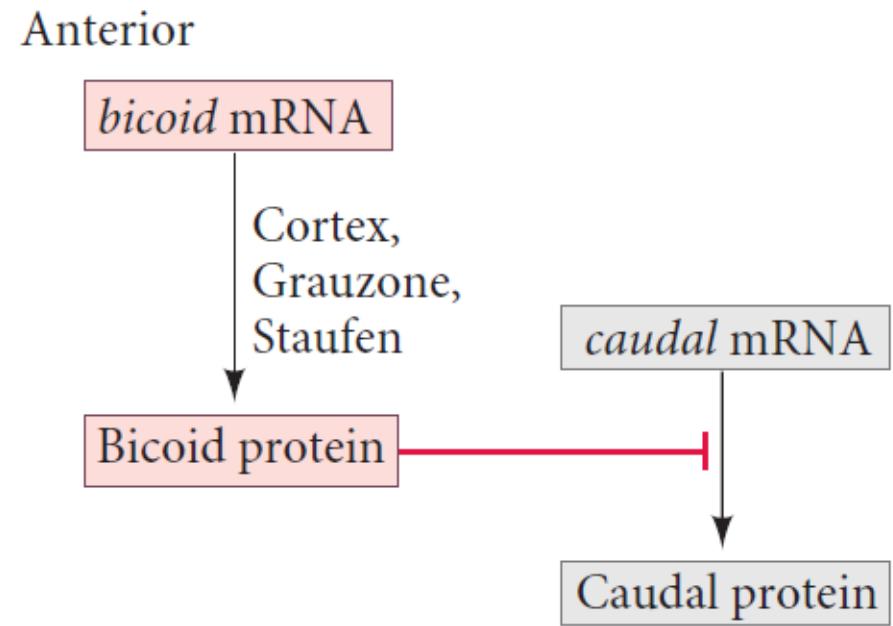
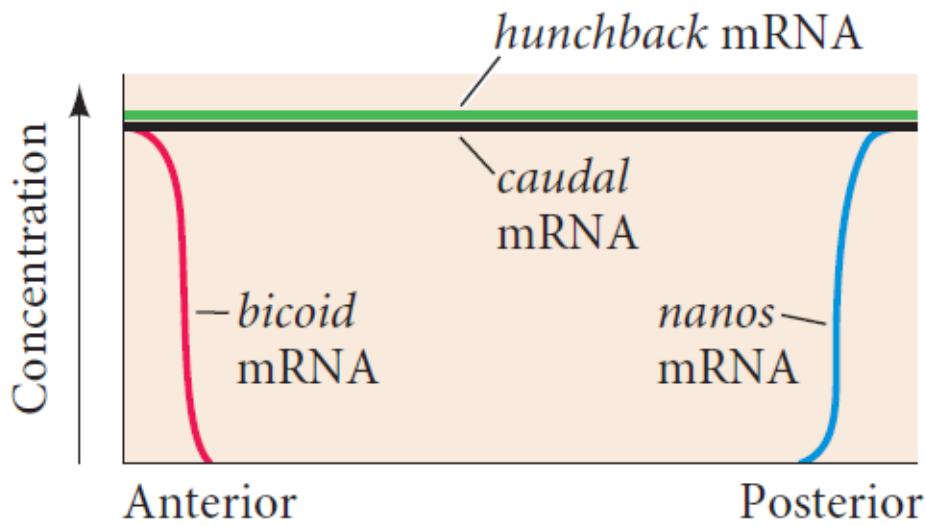
40 min











(B) Early cleavage embryo proteins

