

Desarrollo temprano en metazoarios I



Gonzalo Aparicio

Clivaje (o segmentación)

Blástula

Gastrulación

Embrión trilaminar:

Endodermo

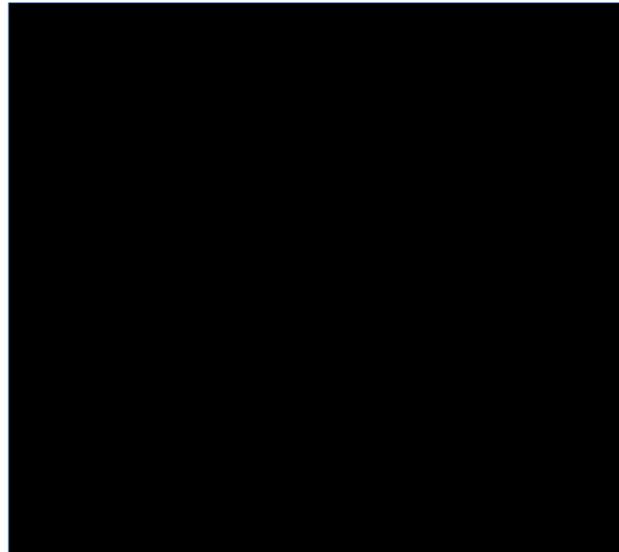
Mesodermo

Ectodermo

Inducción neural

Neurulación

Sistema nervioso



Patrones de desarrollo en metazoarios

Organismo eucariota

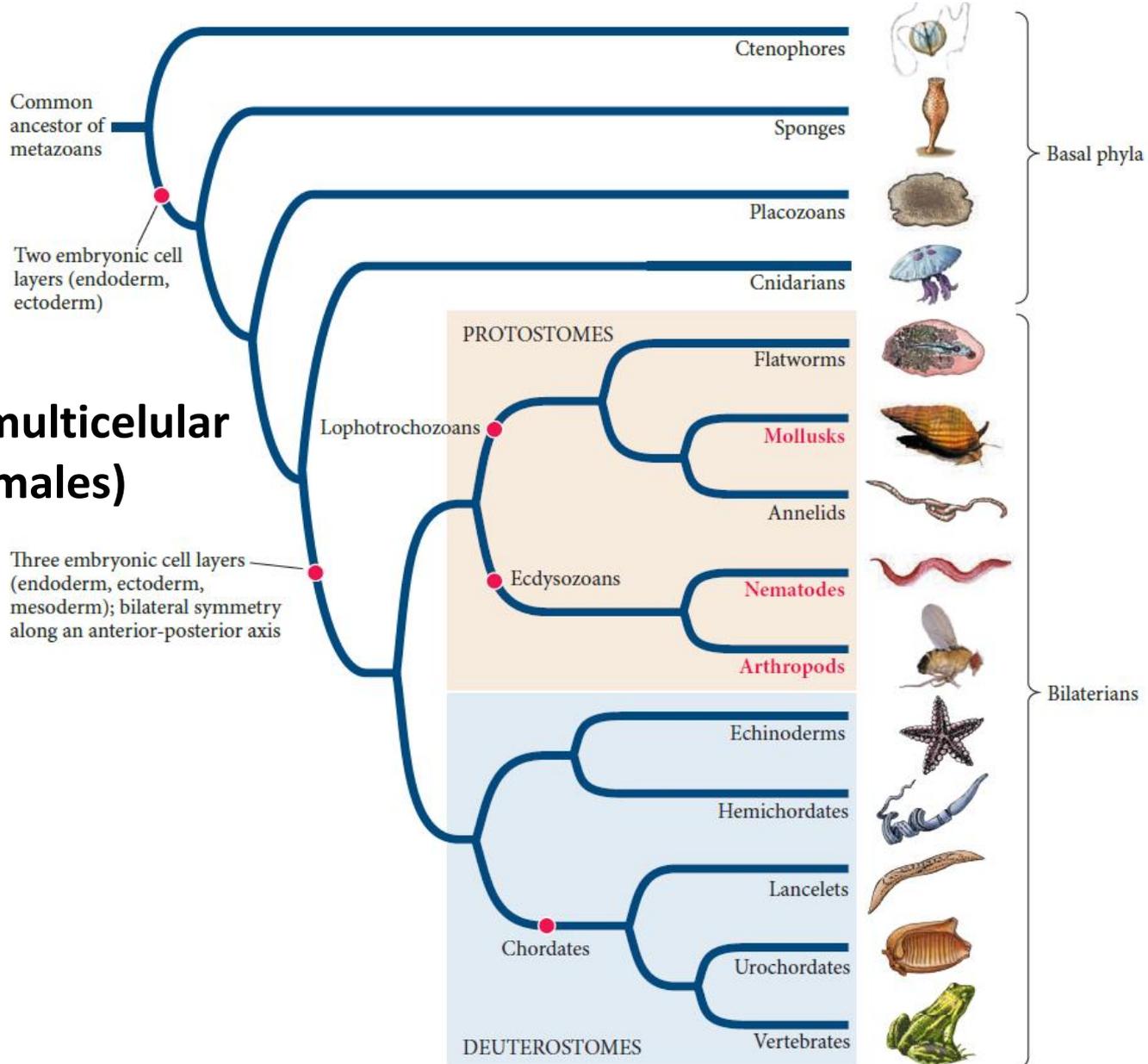
Célula con núcleo

Organismo eucariota multicelular (plantas, hongos y animales)

Células generadas por Mitosis adheridas unas a otras

Metazoario

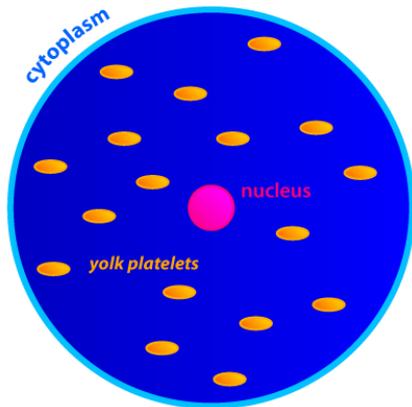
Gastrulación



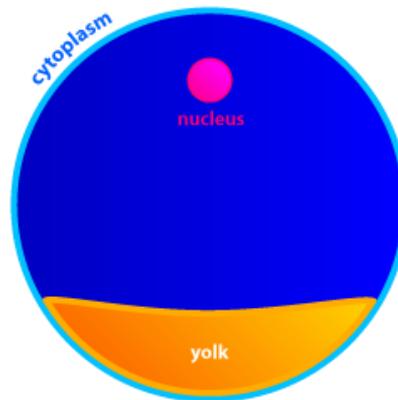
Clivaje

Serie de divisiones celulares iniciales que experimenta el embrión

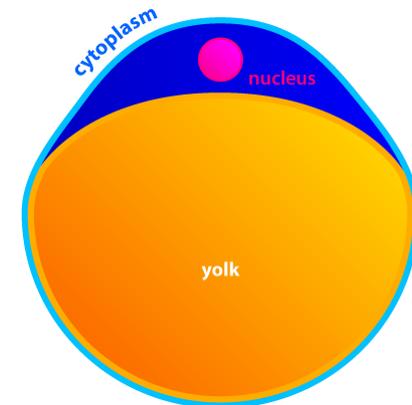
Orientación y velocidad de segmentación condicionada por el contenido de **vitelo**



Isolecito
(cantidad vitelo escasa,
distribuido
homogéneamente)

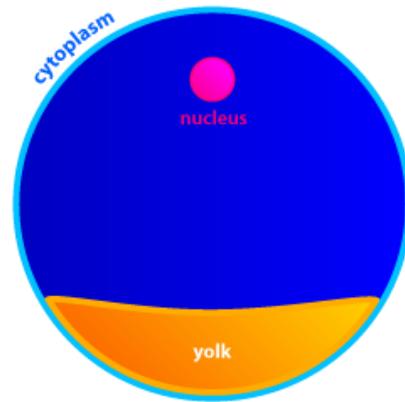


Mesolecito
(cantidad de vitelo moderada,
distribuido
hacia la región vegetal)



Telolecito
(gran cantidad de vitelo,
distribuido
en casi toda la célula)

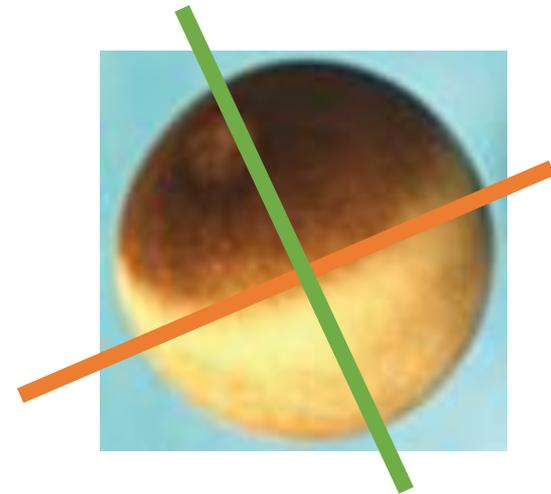
Polo Animal



Polo vegetal

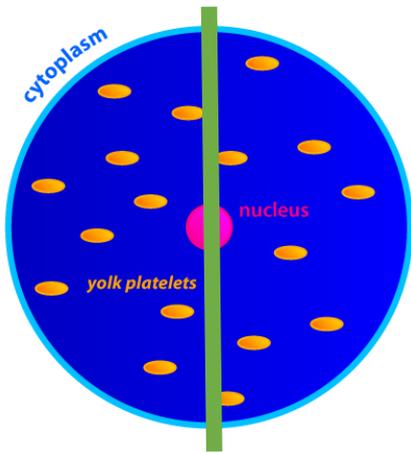


Cantidad de vitelo

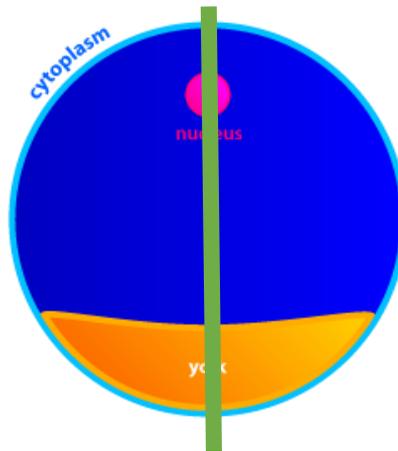


**Plano de división
ecuatorial**

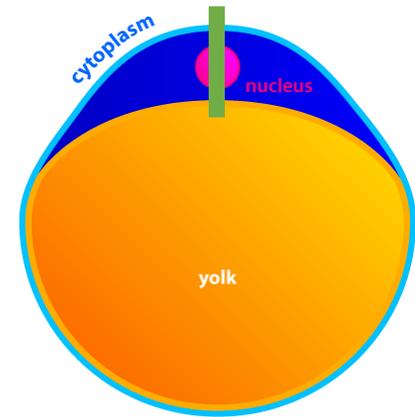
**Plano de división
meridional**



**Segmentación
Holoblástica
(completa)**



**Segmentación
Holoblástica
(completa)**



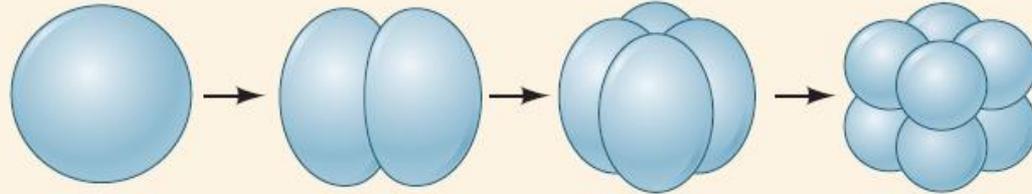
**Segmentación
Meroblástica
(parcial)**

I. HOLOBLASTIC (COMPLETE) CLEAVAGE

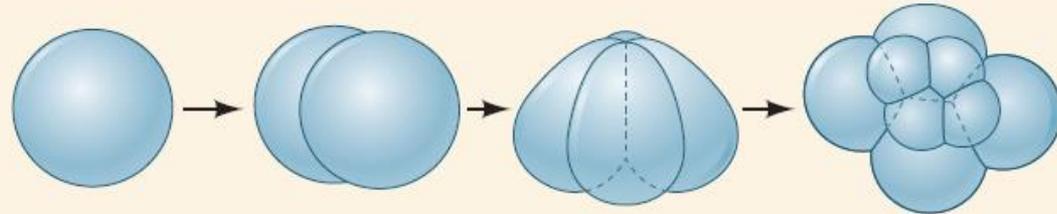
A. Isolecithal

(Sparse, evenly distributed yolk)

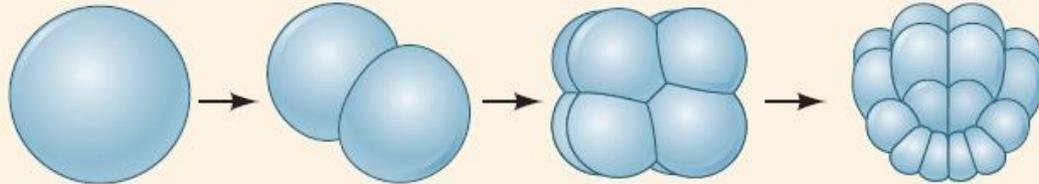
1. Radial cleavage
Echinoderms, amphioxus



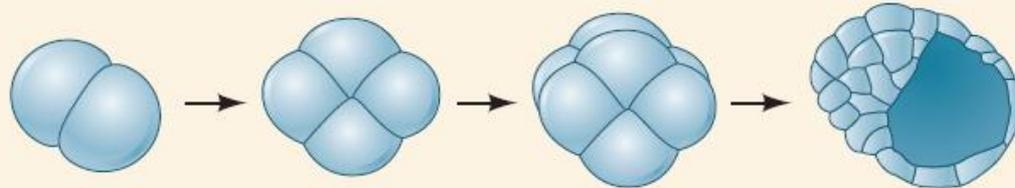
2. Spiral cleavage
Annelids, molluscs,
flatworms



3. Bilateral cleavage
Tunicates



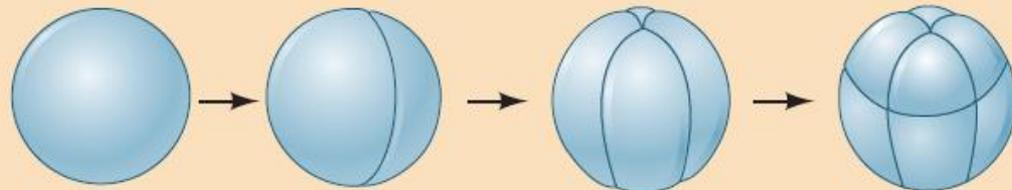
4. Rotational cleavage
Mammals, nematodes



B. Mesolecithal

(Moderate vegetal yolk disposition)

- Displaced radial cleavage
Amphibians

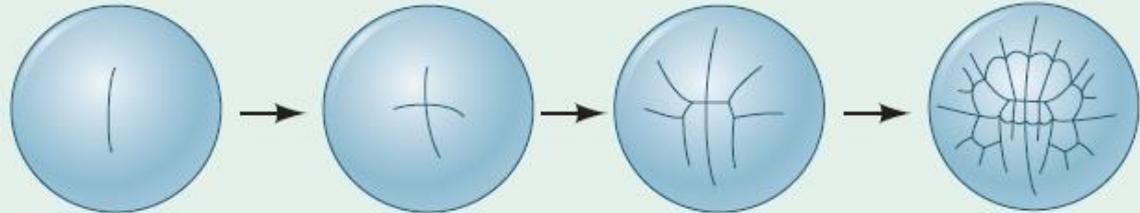


II. MEROBLASTIC (INCOMPLETE) CLEAVAGE

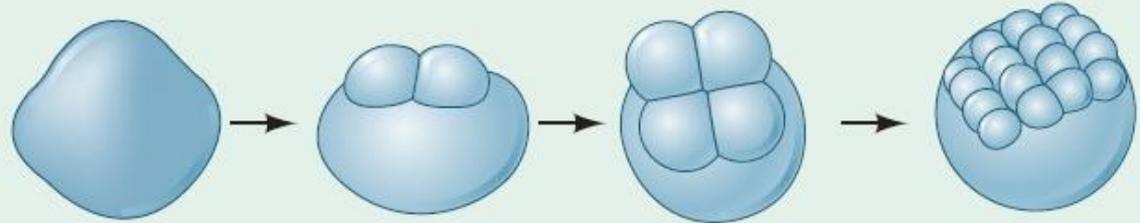
A. Telolecithal

(Dense yolk throughout most of cell)

1. Bilateral cleavage
Cephalopod molluscs



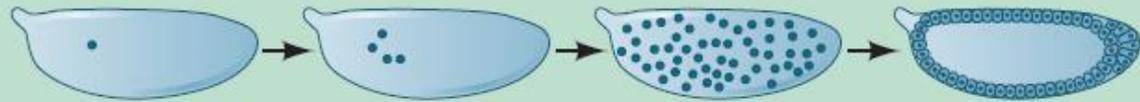
2. Discoidal cleavage
Fish, reptiles, birds



B. Centrolecithal

(Yolk in center of egg)

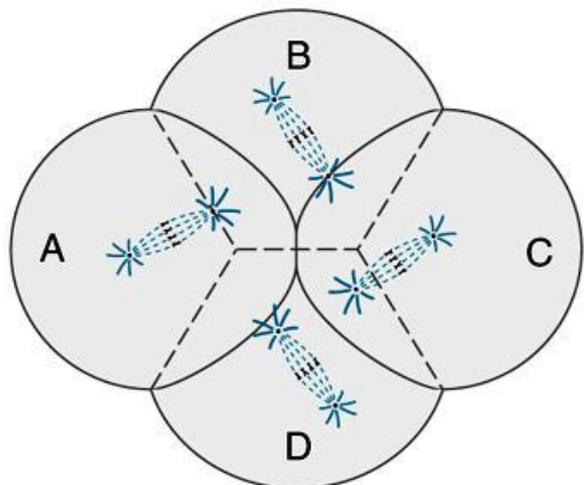
- Superficial cleavage
Most insects



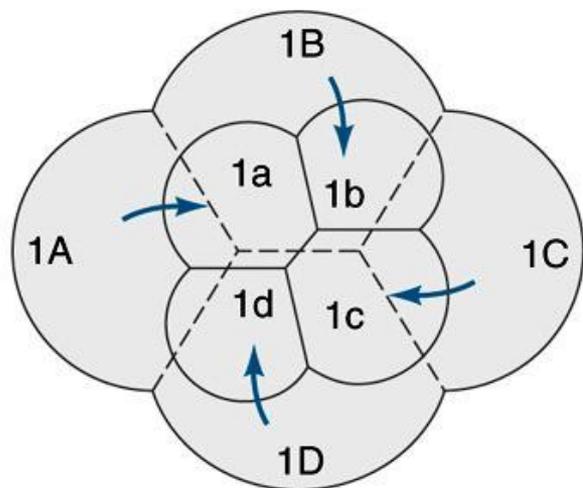
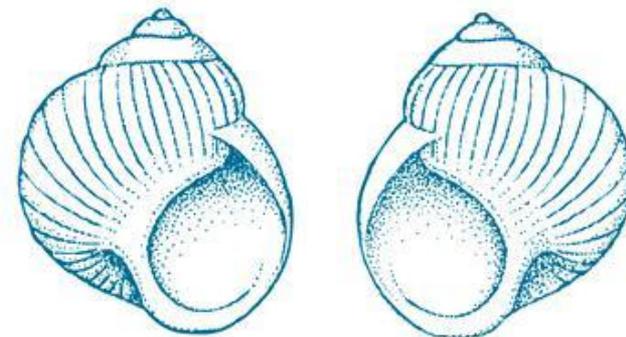
Ejemplos

Patrones de segmentación

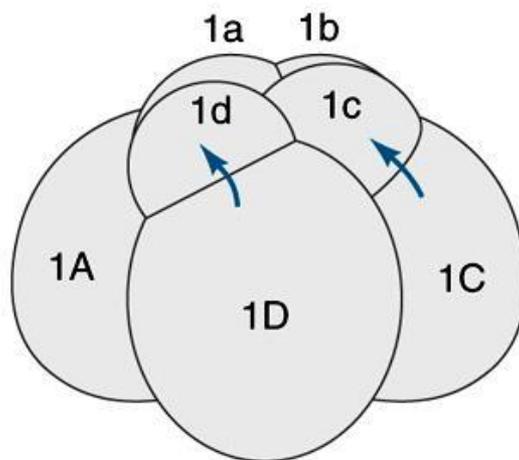
Clivaje holoblástico espiral: moluscos



(a)

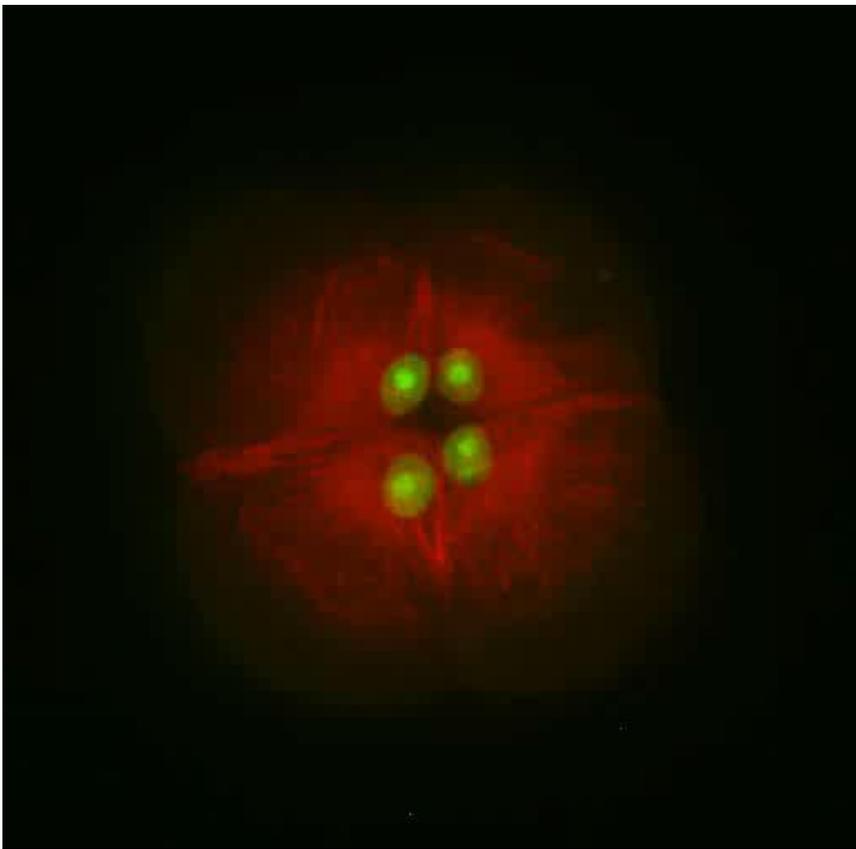


(b)



(c)

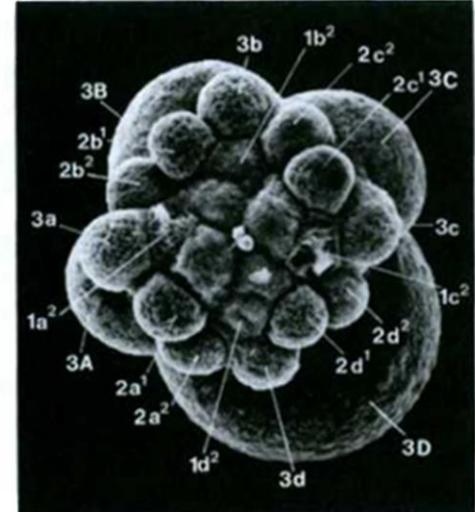
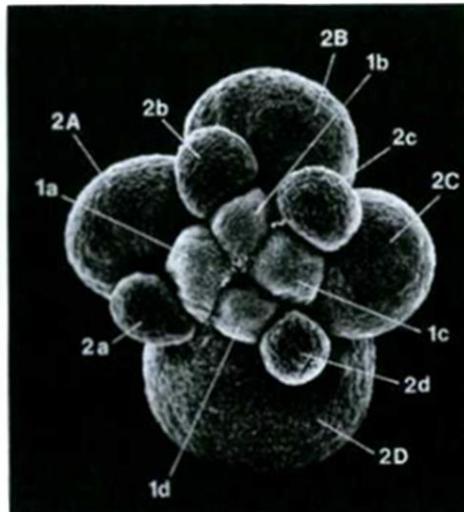
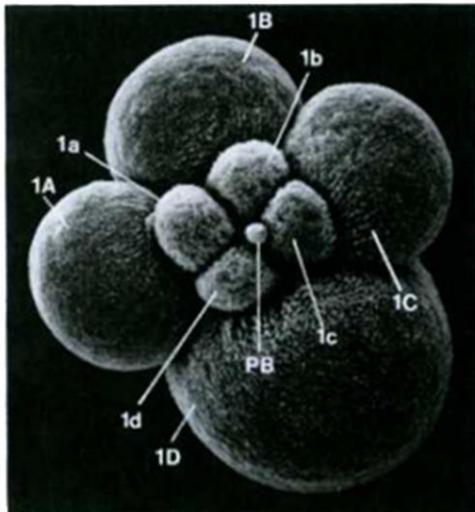
Moluscos
Anélidos
Platelmintos



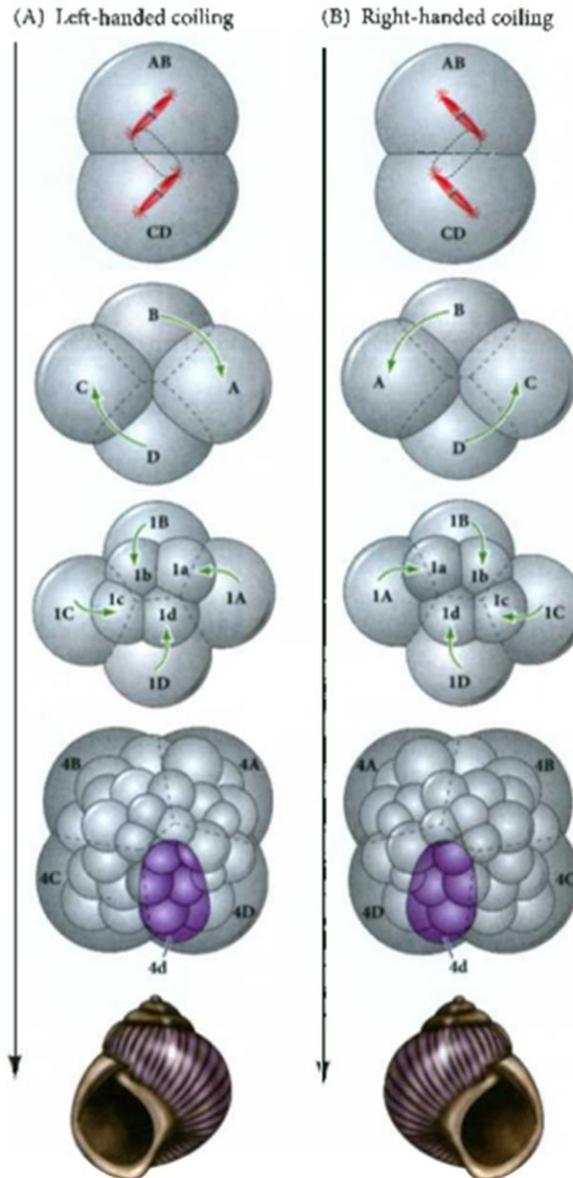
Verde/amarillo: ADN

Rojo: microtúbulos

<http://11e.devbio.com/wd0801.html>



Orientación patrón de segmentación



Regulación del patrón de segmentación

Genotipo

Fenotipo

DD hembra x **dd** macho

Dd

Enrollamiento derecha

DD macho x **dd** hembra

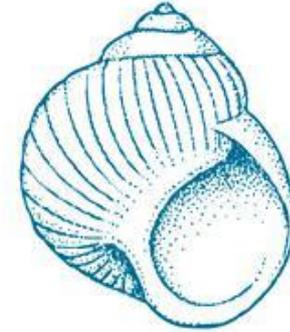
Dd

Enrollamiento izquierda

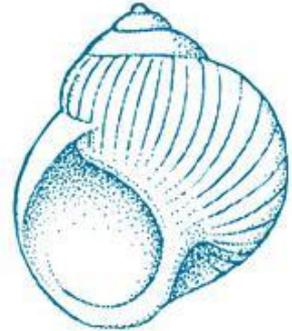
Ddx**Dd**

1DD:2Dd:1dd

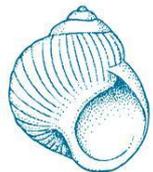
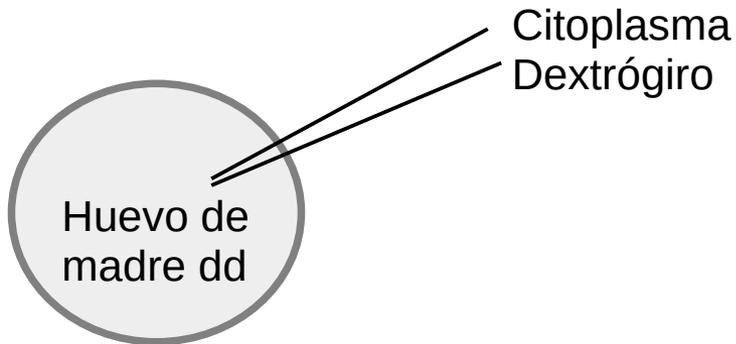
Enrollamiento derecha



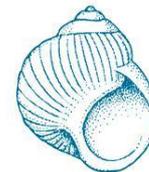
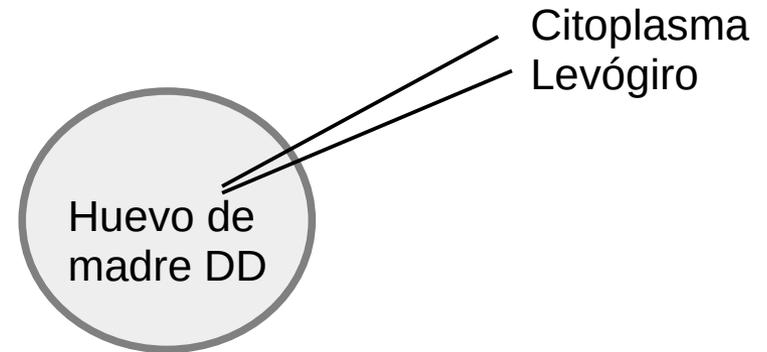
Derecha



Izquierda

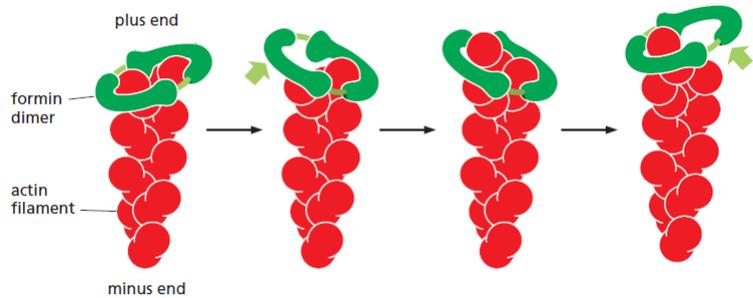
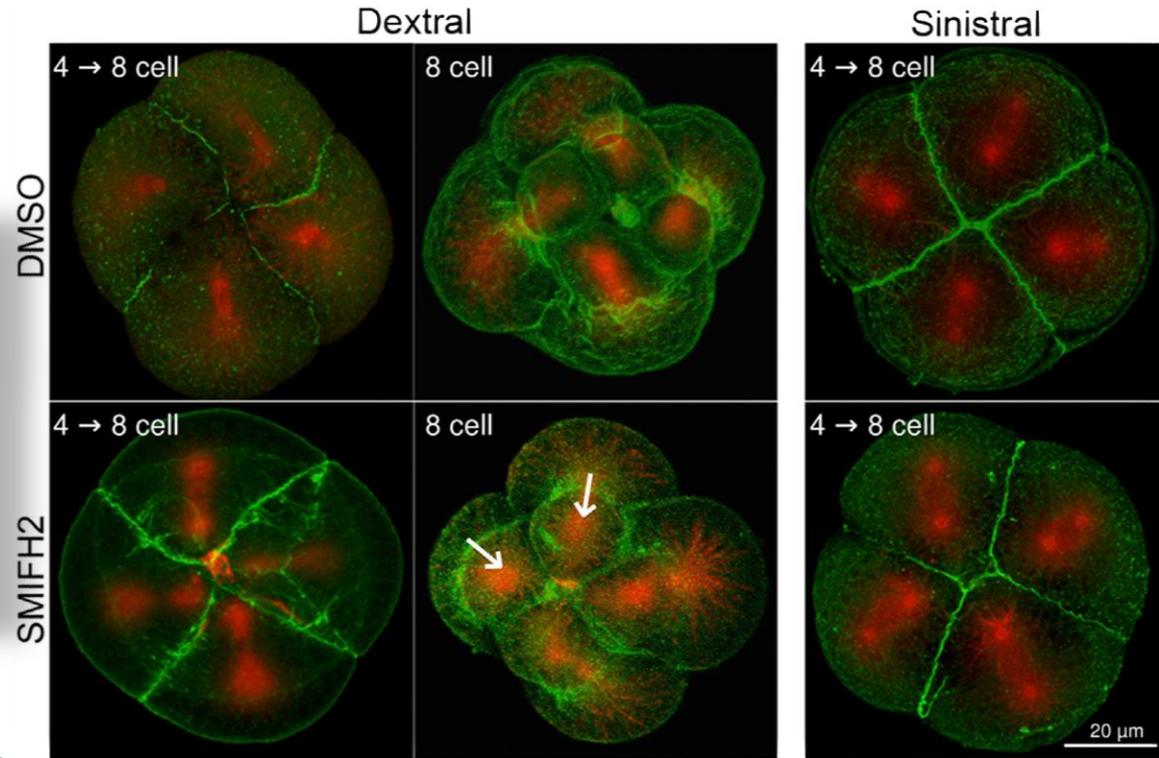
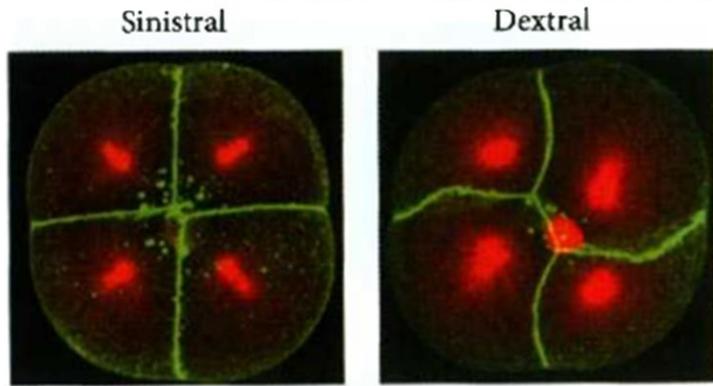


Derecho



Derecho

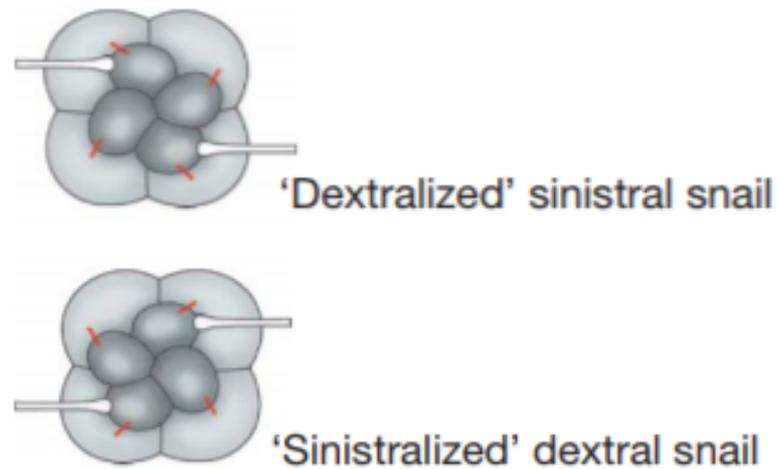
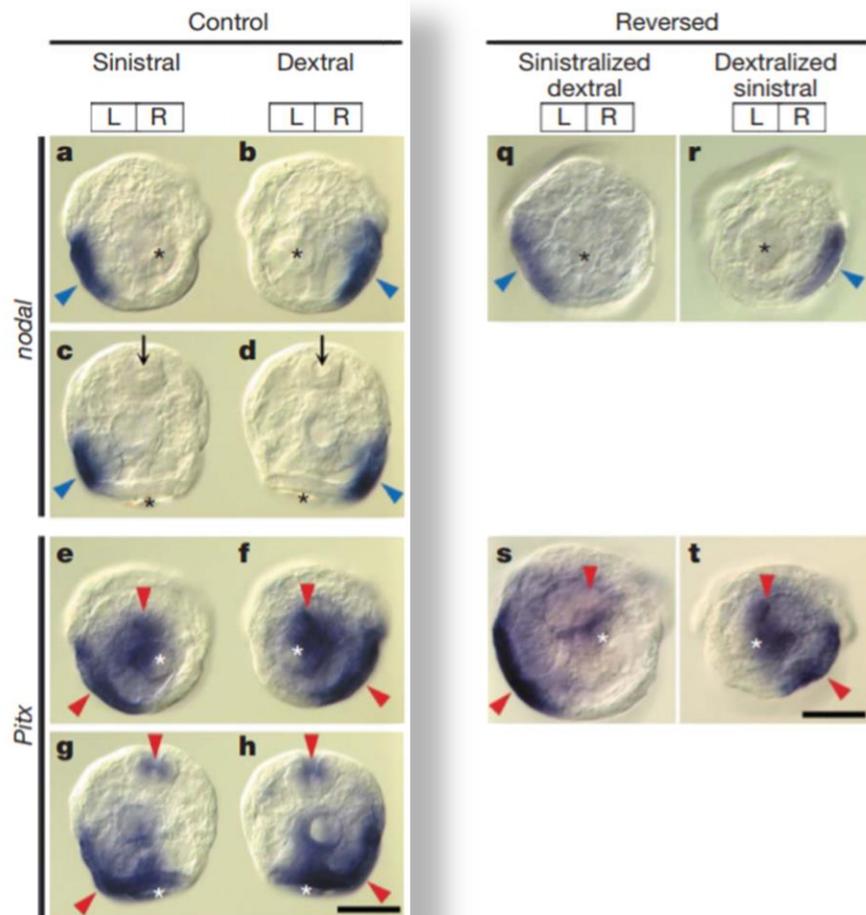
Formina: proteína de unión a microfilamentos



LETTERS

Chiral blastomere arrangement dictates zygotic left–right asymmetry pathway in snails

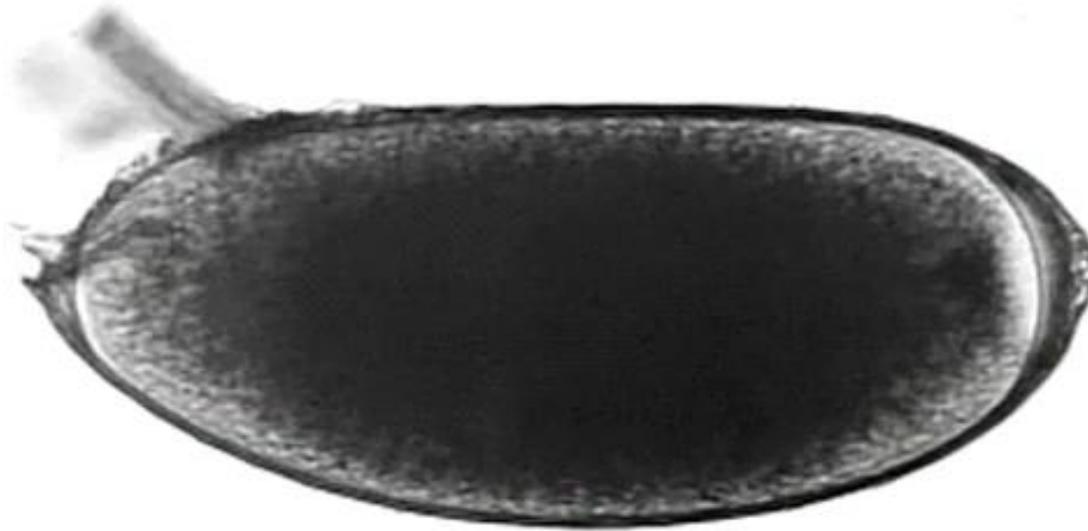
Reiko Kuroda^{1,2,3}, Bunshiro Endo², Masanori Abe² & Miho Shimizu²



Clivaje meroblástico superficial: insectos



21:26:38

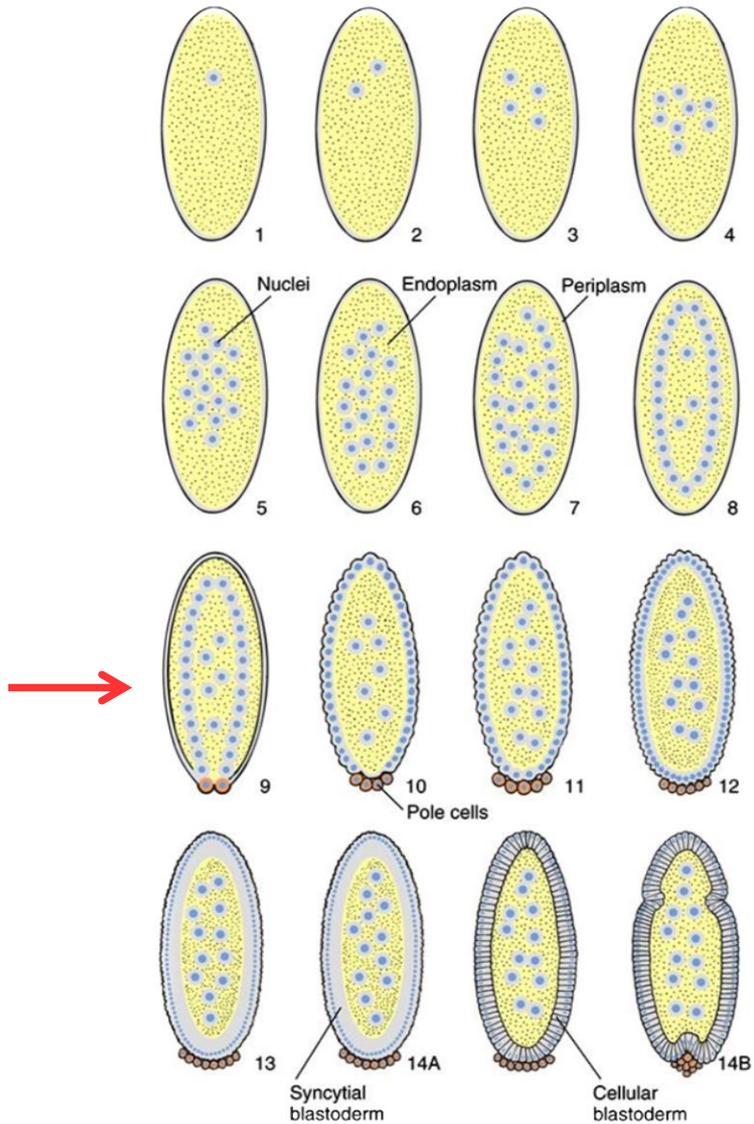


<https://youtu.be/wYtzygo5Ucl>

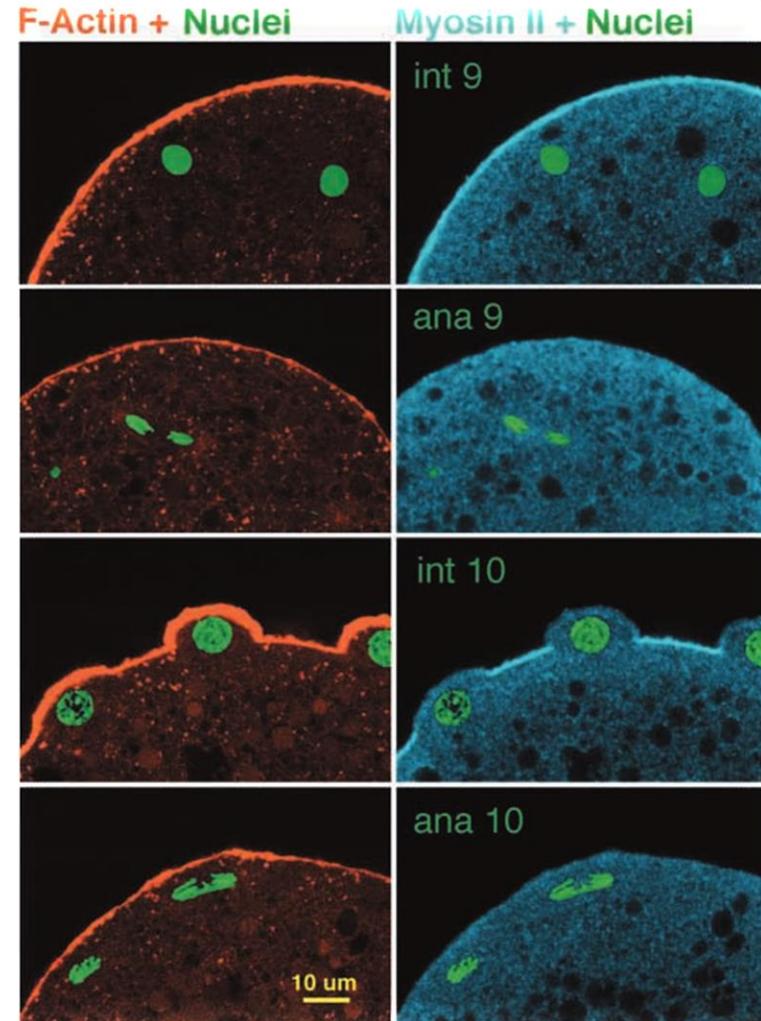
Huevos
centrolecitos

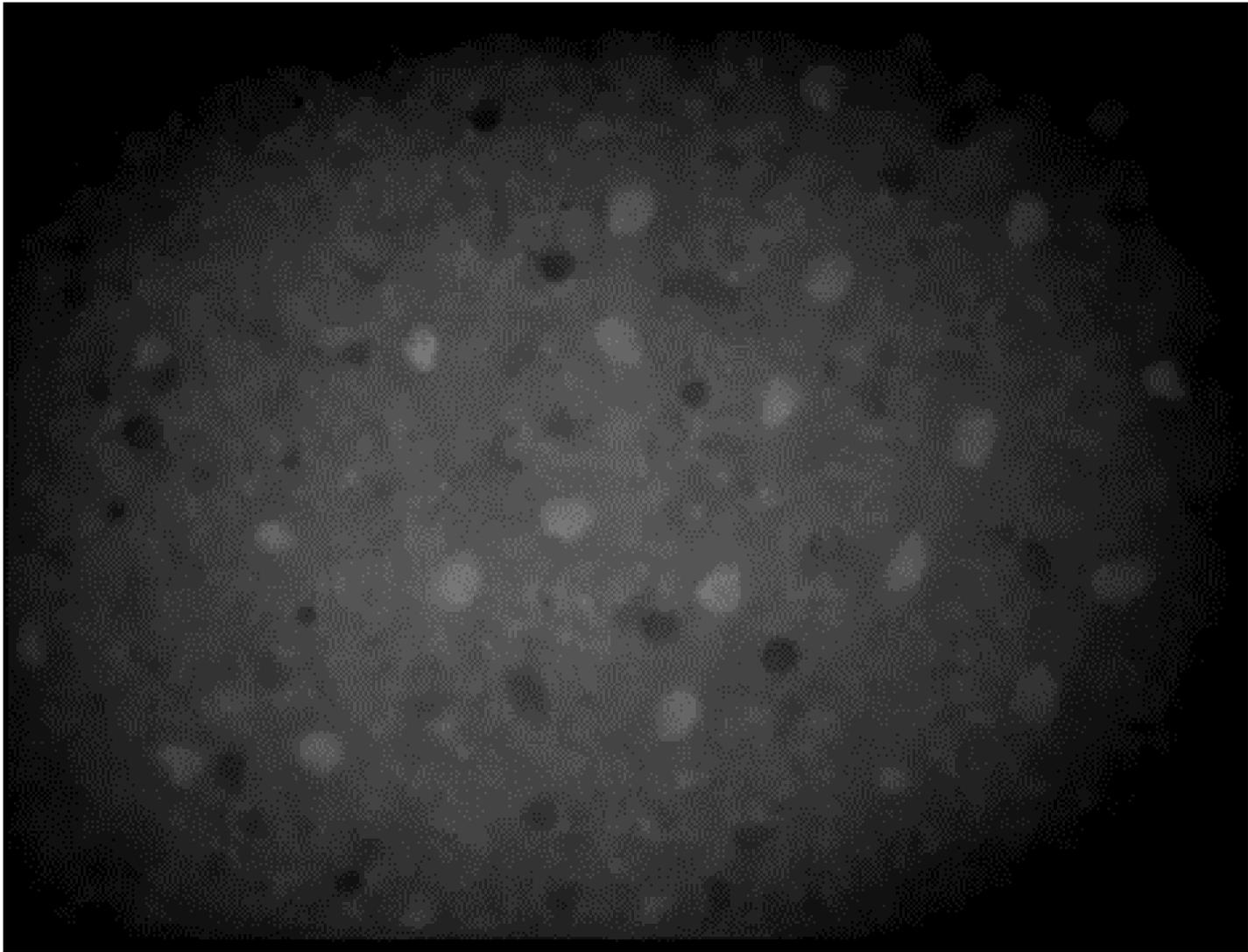


Migración nuclear a la periferia celular



Blastodermo sincitial





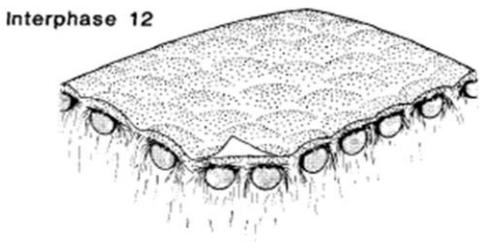
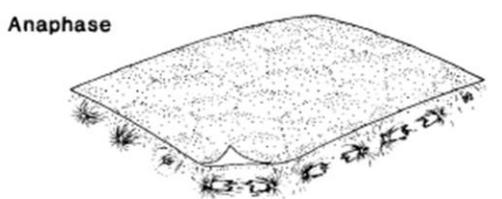
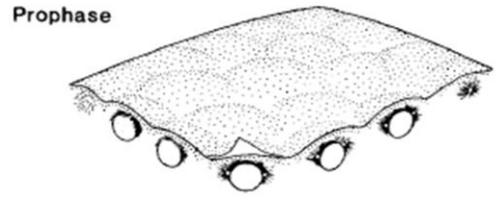
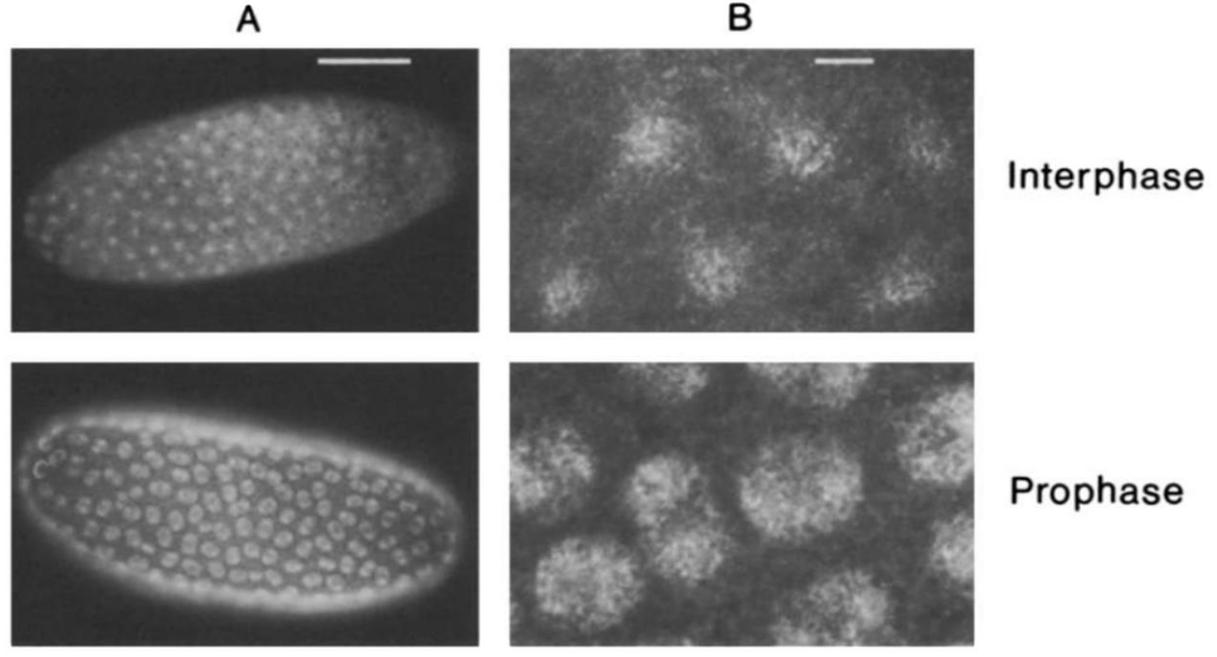
<http://11e.devbio.com/wd0902.html>

Organization of the Cytoskeleton in Early *Drosophila* Embryos

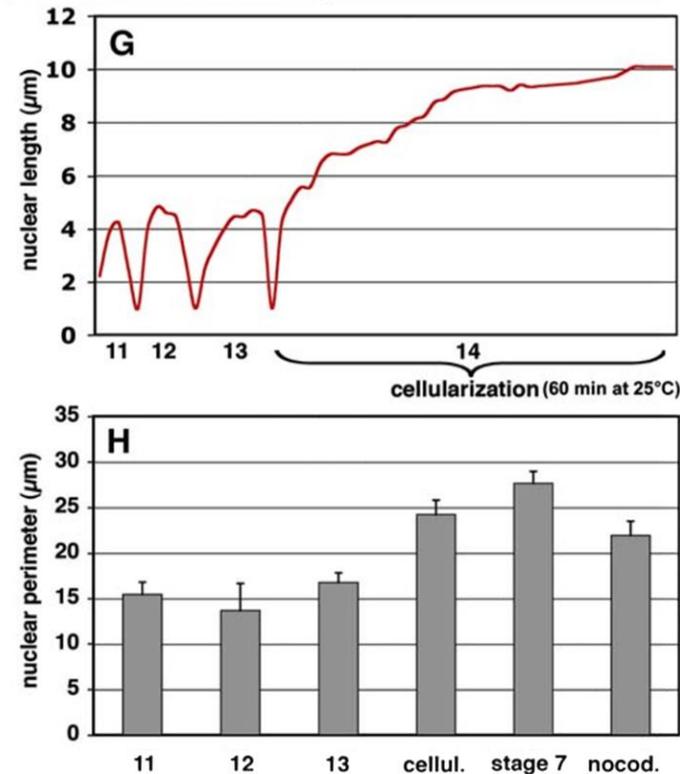
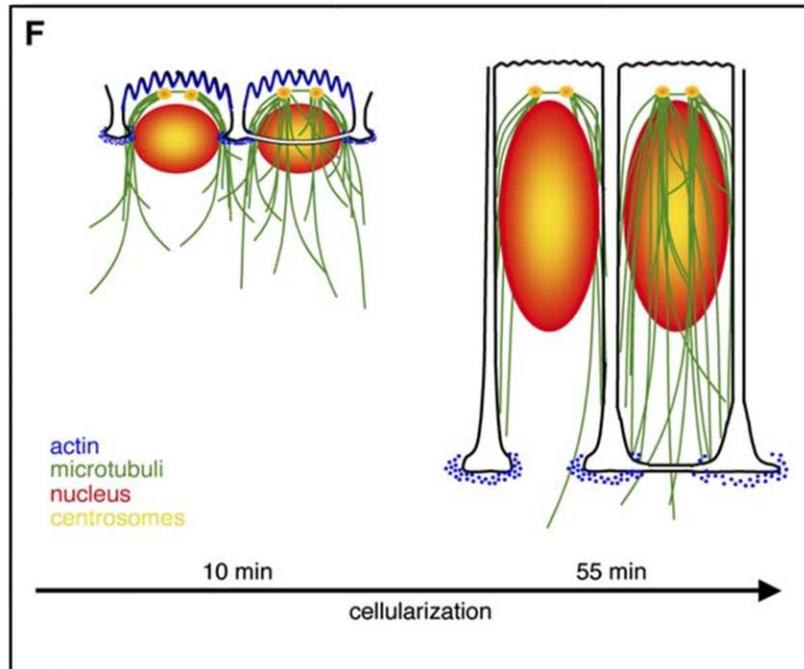
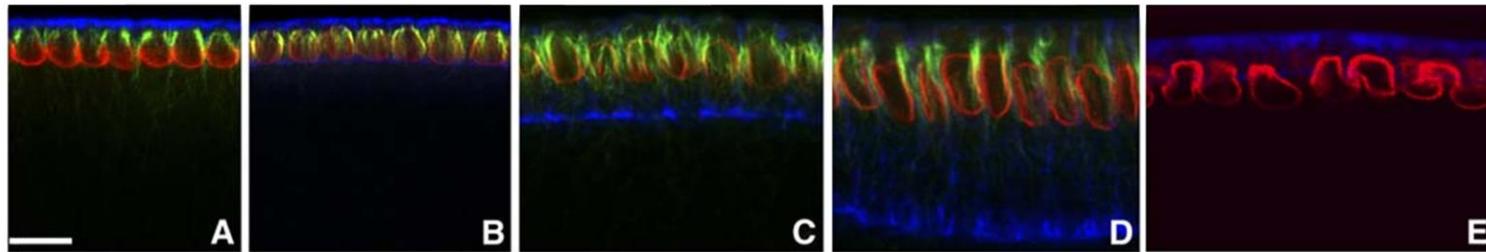
Timothy L. Karr and Bruce M. Alberts

Department of Biochemistry and Biophysics, University of California, San Francisco, California 94143

Islas de citoplasma y citoesqueleto rodeando a los núcleos del sincitio: **enérgidas**



Celularización: blastodermo celular



6000 células, 4hpf!!!

Transición de la blástula media

Activación del genoma del embrión

Divisiones 1-10

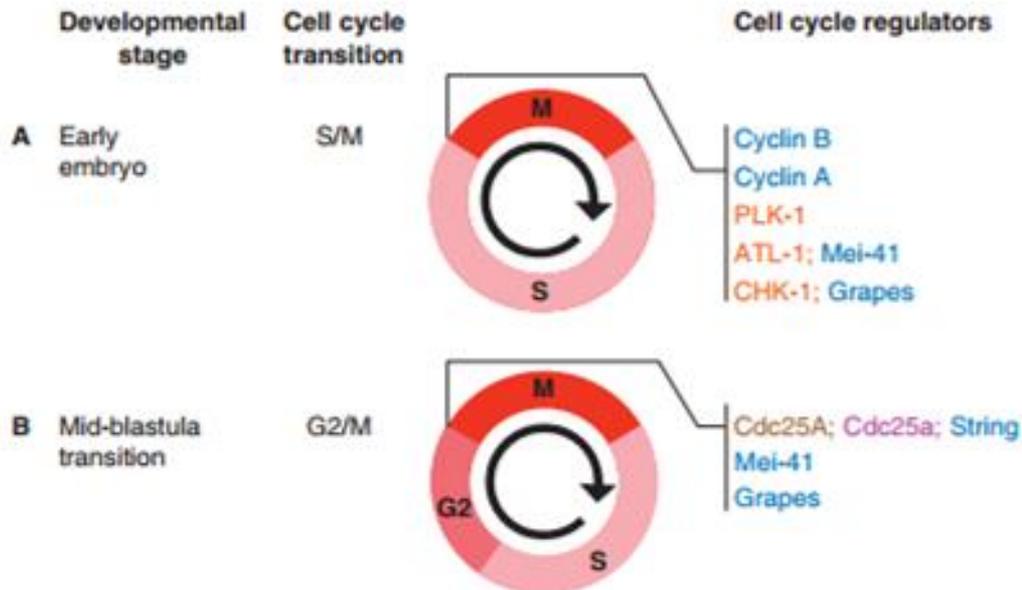
8 minutos

Ciclo 13

25 minutos

Ciclo 14

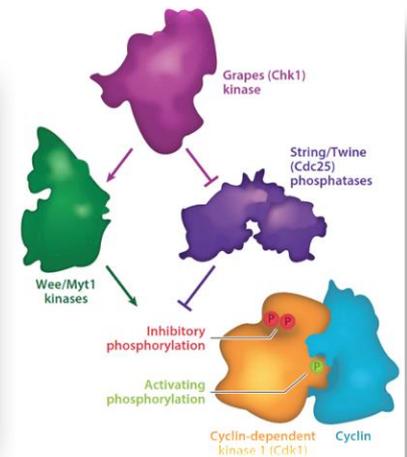
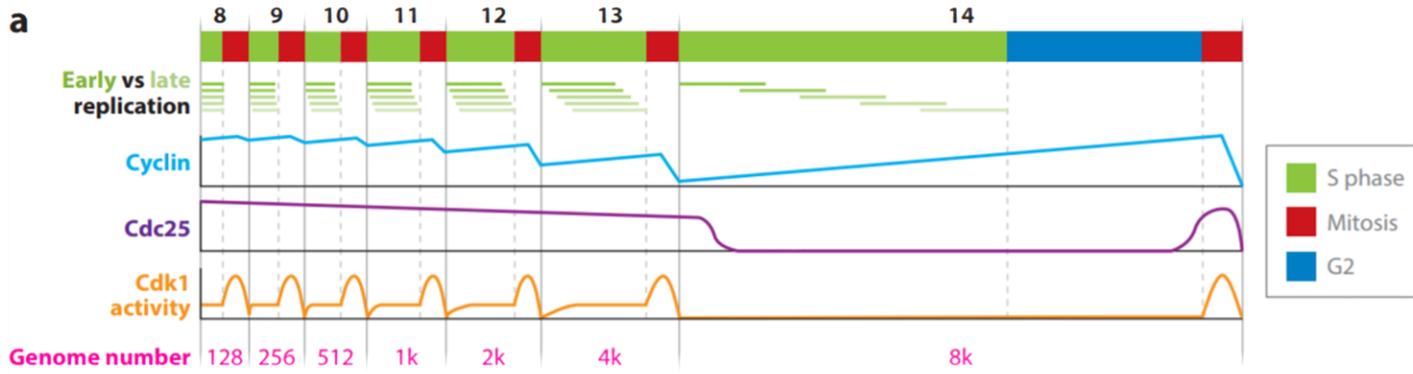
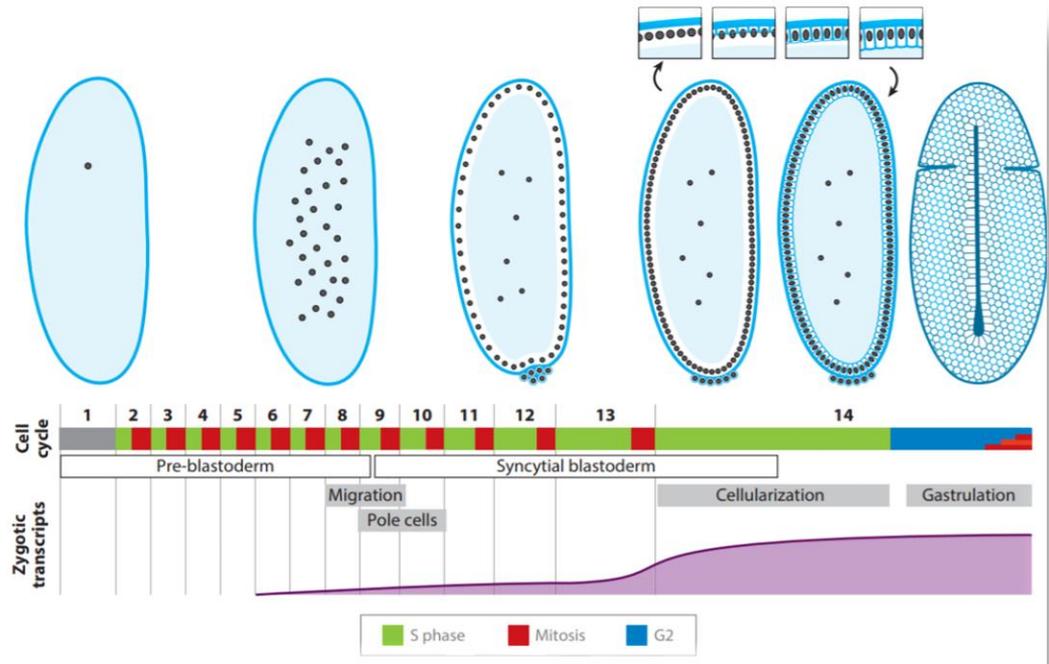
75-175 minutos



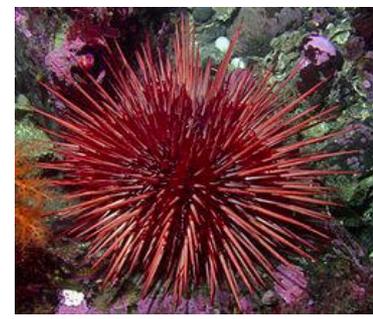
Pérdida de sincronía

From Egg to Gastrula: How the Cell Cycle is Remodeled During the *Drosophila* Mid-Blastula Transition

Jeffrey A. Farrell¹ and Patrick H. O'Farrell²



Clivaje holoblástico radial: equinodermos

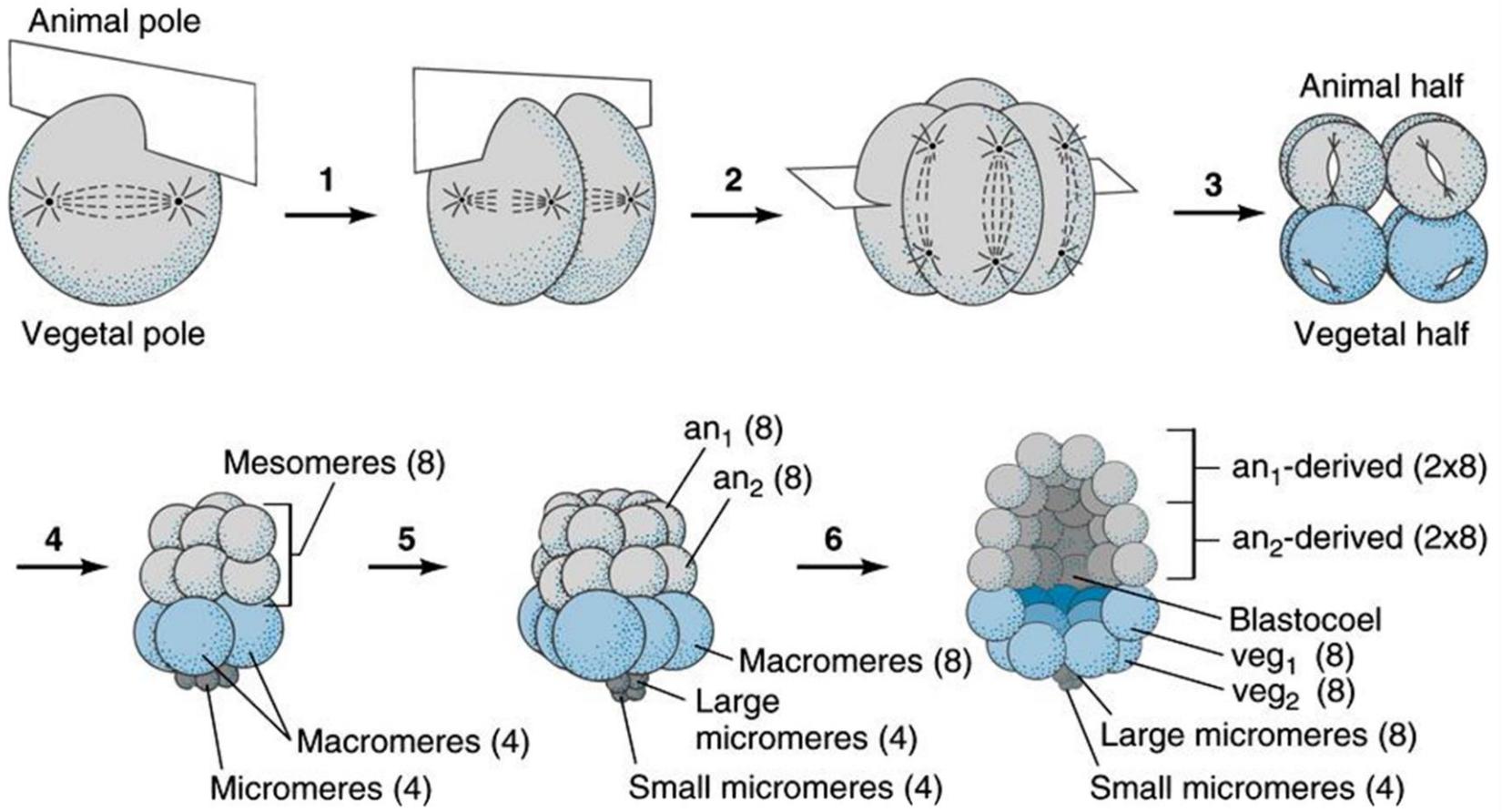


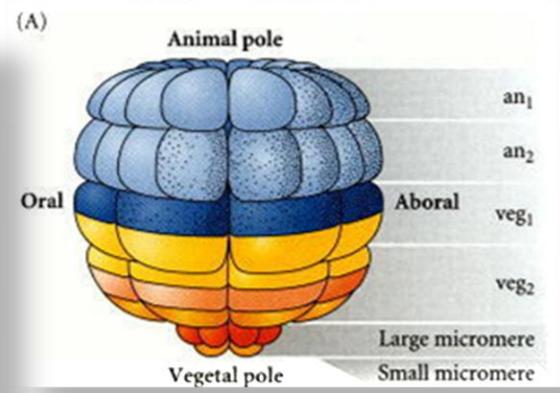
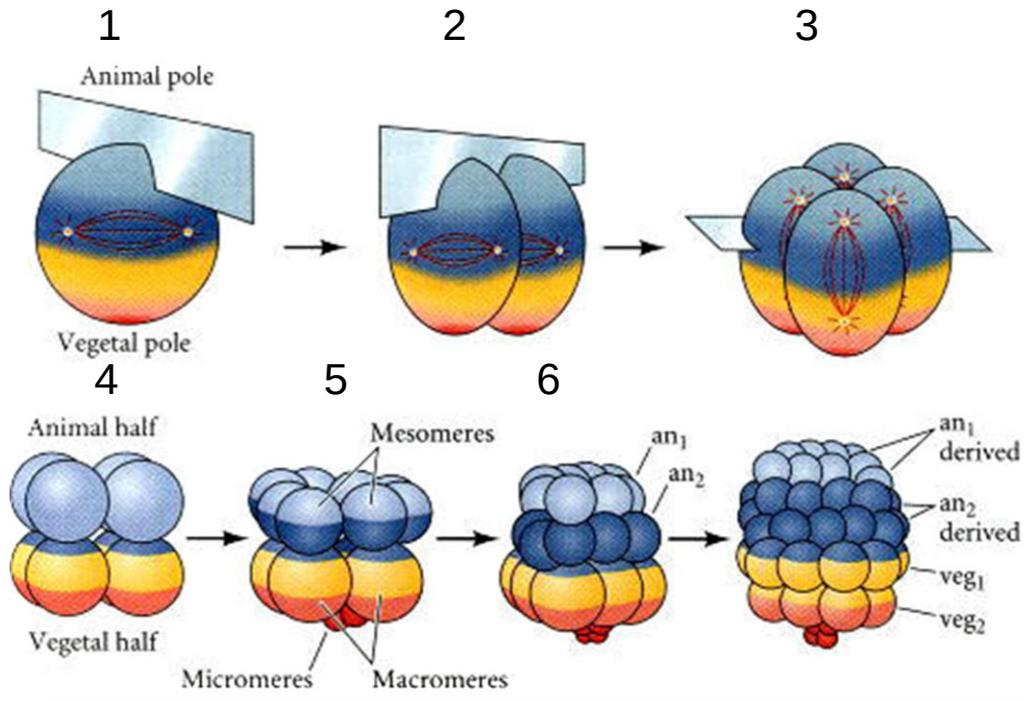
<https://www.youtube.com/watch?v=F6zCp29awxA>

Huevos isolecitos
Simetría radial

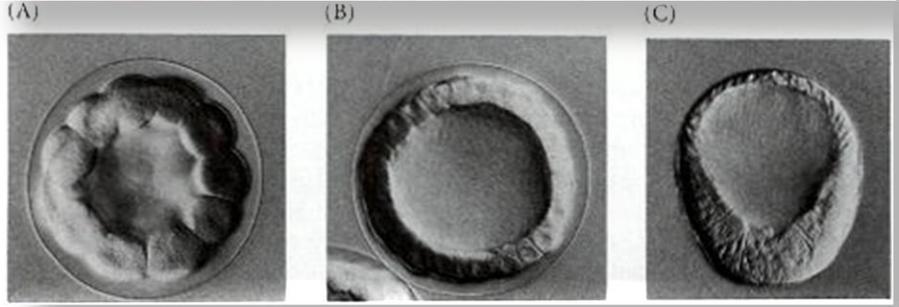
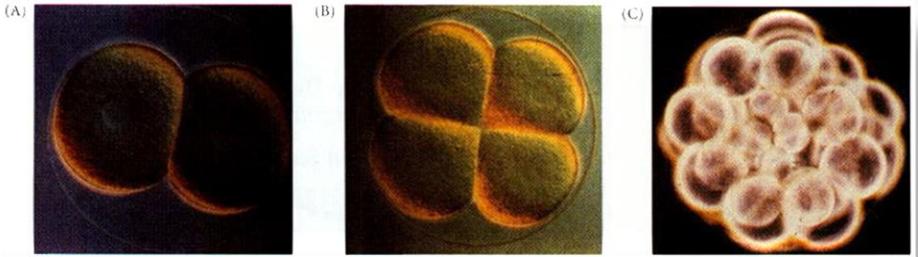


Clivaje holoblástico radial: equinodermos

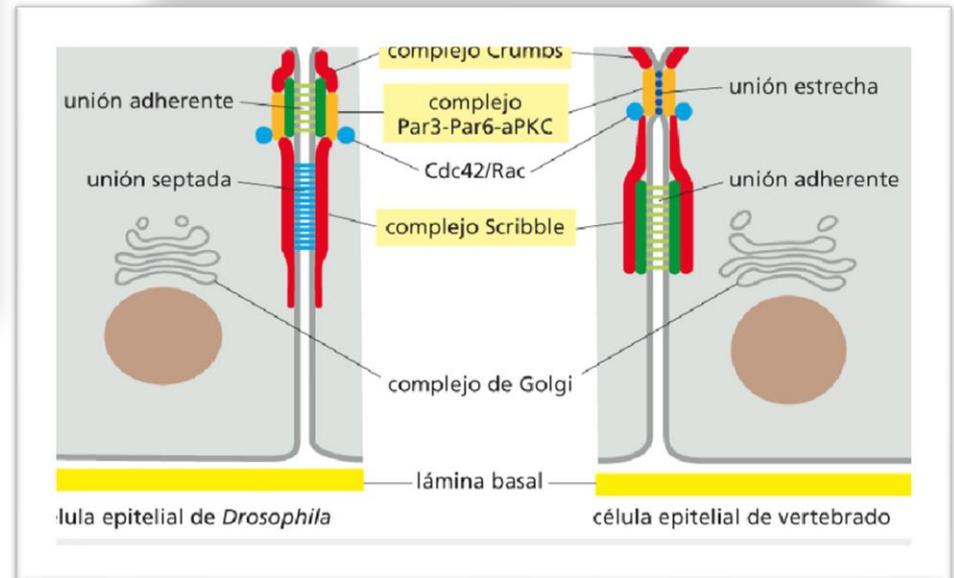
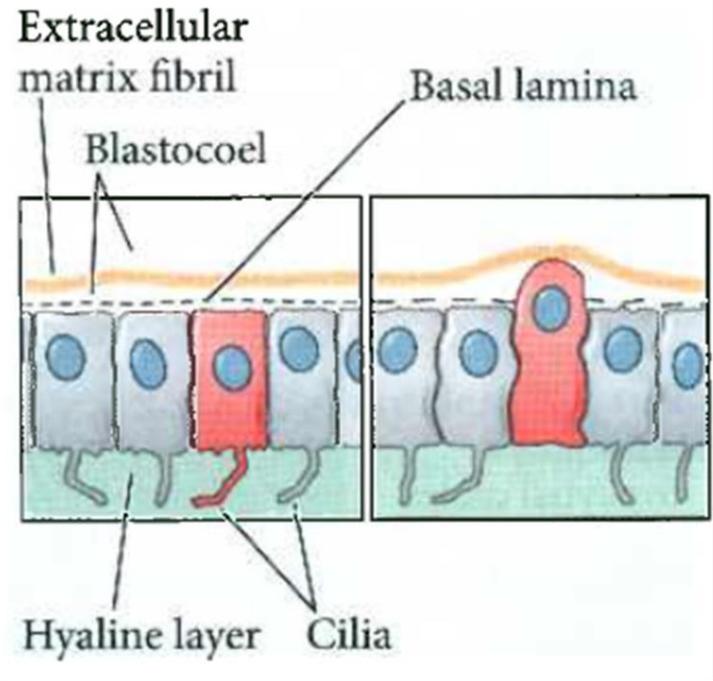
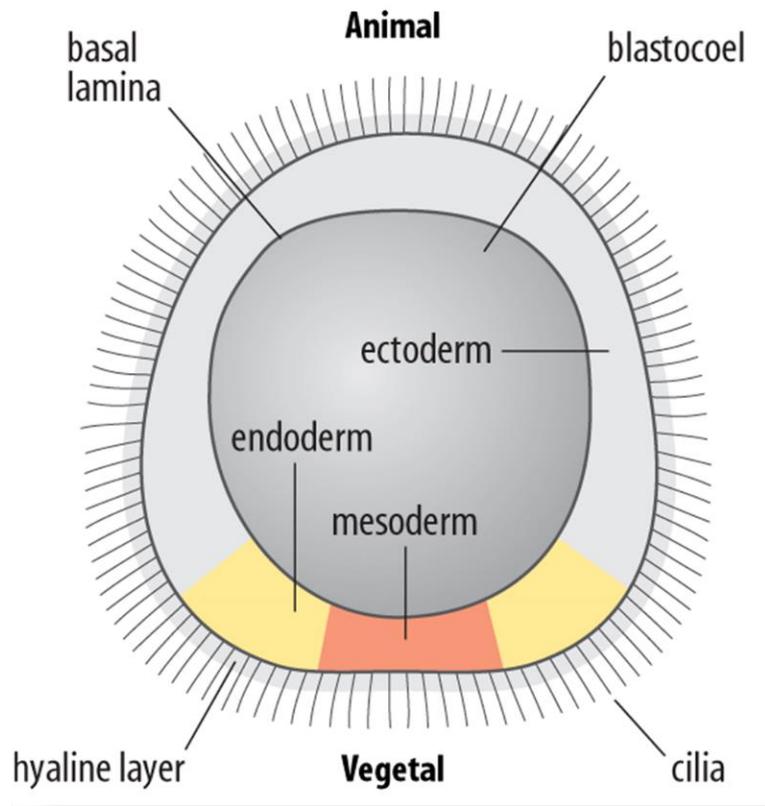




	Aboral ectoderm
	Oral ectoderm
	Endoderm
	Secondary mesenchyme
	Skeletogenic cells
	Coelom

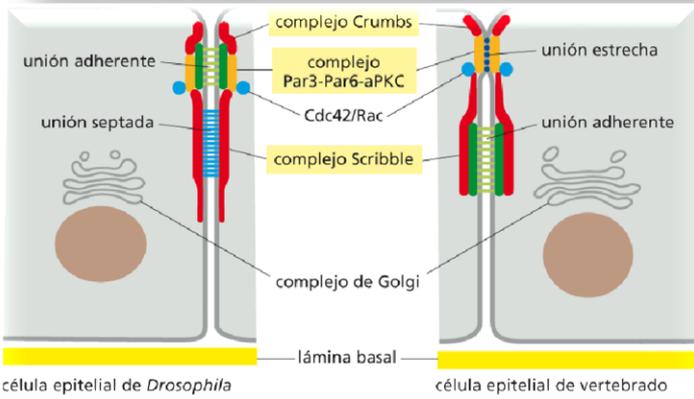
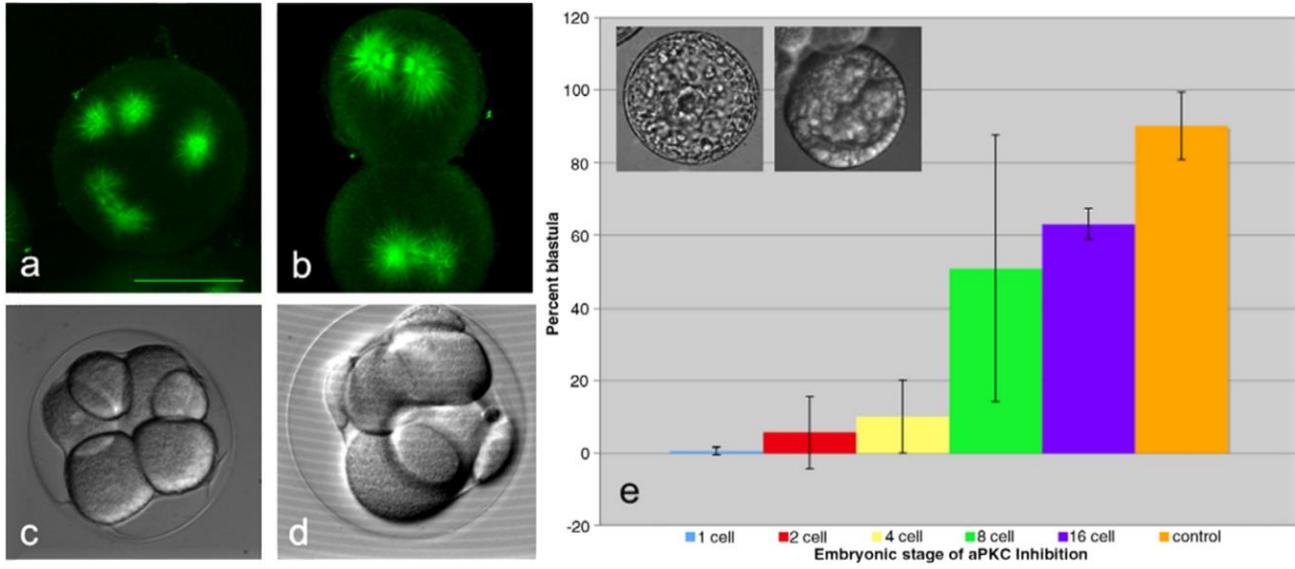


Blástula 120 células

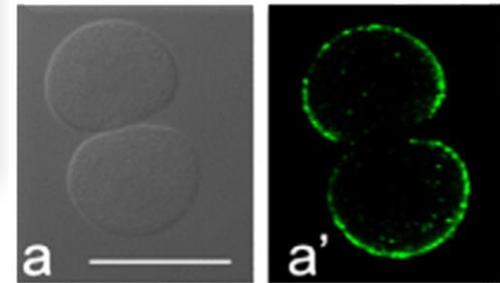


Cell polarity emerges at first cleavage in sea urchin embryos

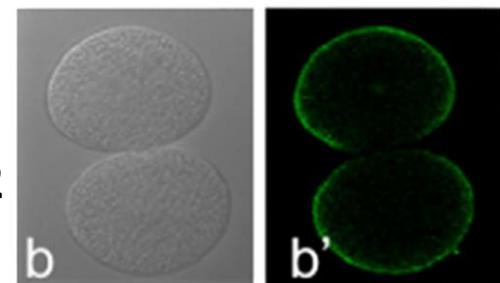
Lea M. Alford, Michelle M. Ng¹, David R. Burgess*



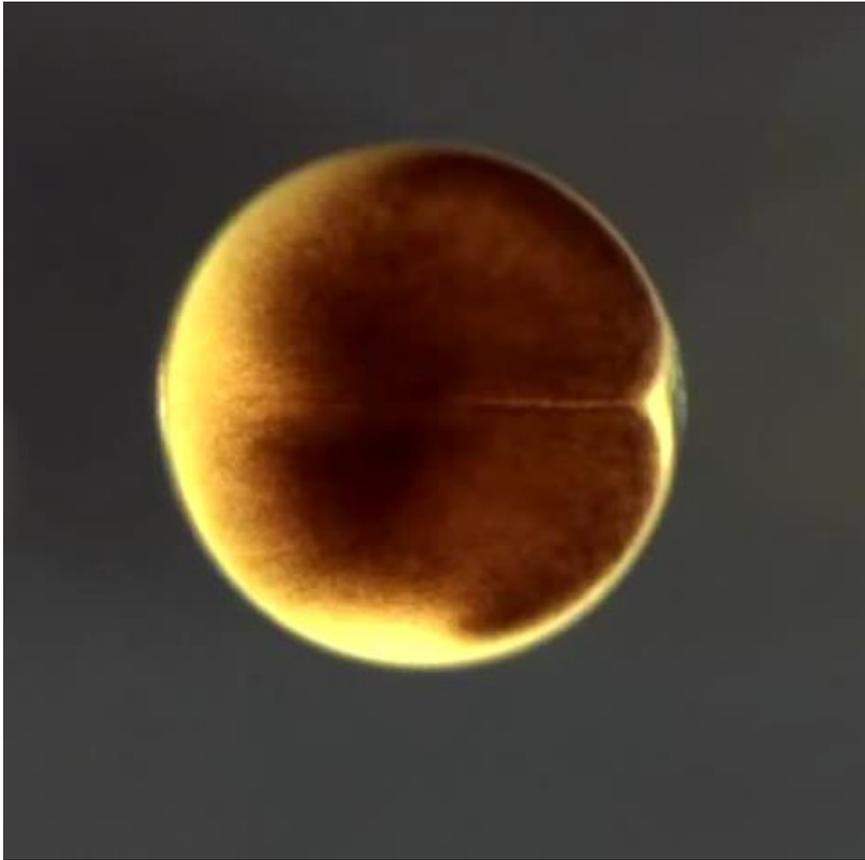
Par6



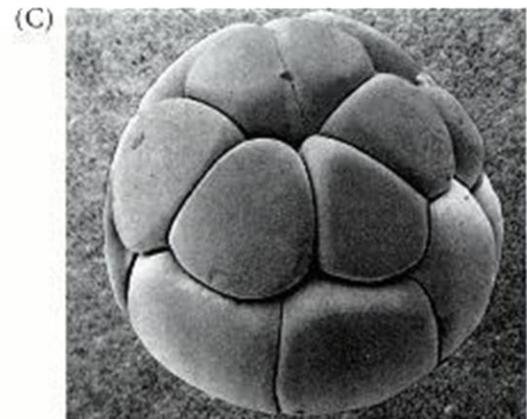
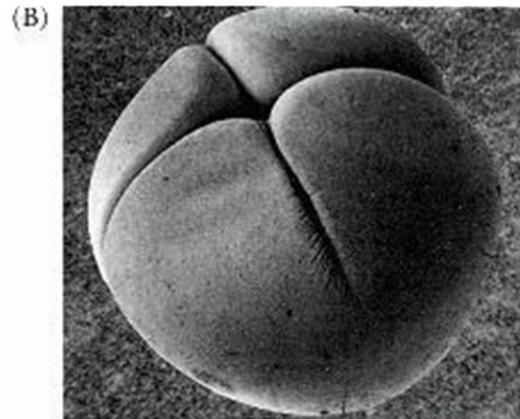
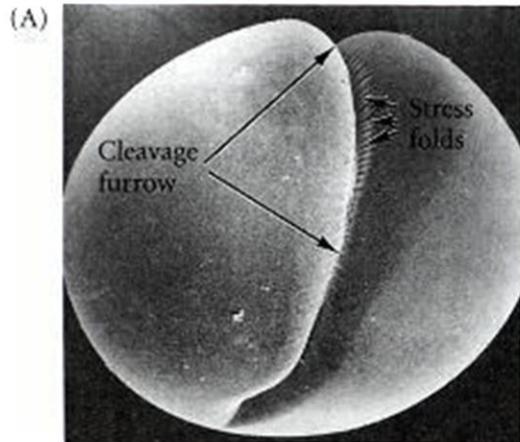
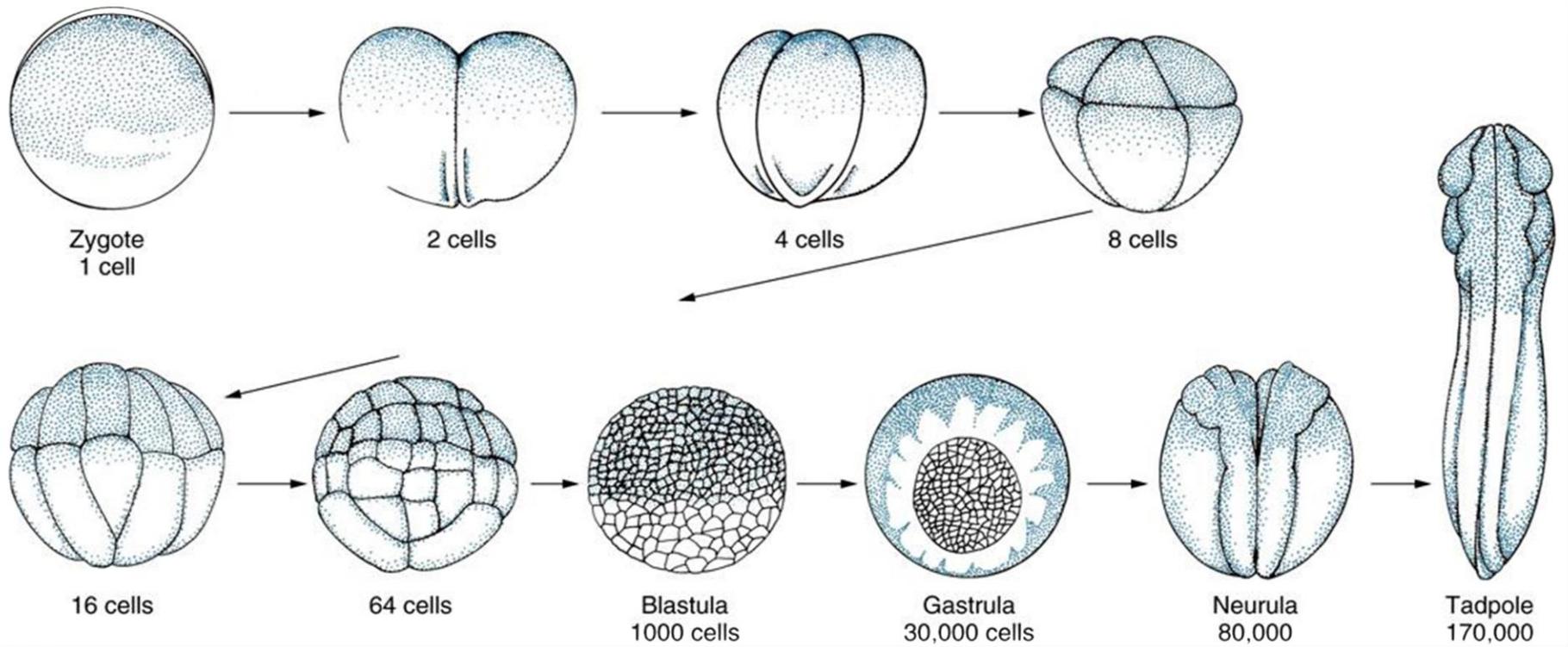
Cdc42



Clivaje holoblástico radial: anfibios



https://www.youtube.com/watch?v=GO5YN_t1fqw



The Cleavage Pattern of the Axolotl Egg Studied by Cinematography and Cell Counting

K. Hara

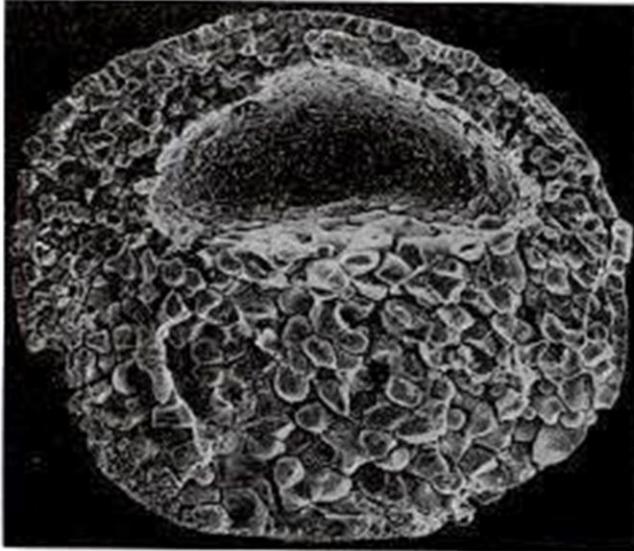
Hubrecht Laboratory, Uppsalalaan 8, DeUithof, Utrecht, Netherlands

Probably the main reason why Balfour's rule has been generally accepted without amendment is that the tip of the cleavage furrow travels faster in the animal than in the vegetative blastomeres. Preliminary measurements indicate that the rate at which the furrow-tip travels during the 2nd to 5th cleavages in the axolotl is about 1 mm/min in the animal cap and 0.02–0.03 mm/min in the vegetative hemisphere. This fact easily tempts one to assume that the animal cells cleave in a much faster rhythm—with a much shorter cell cycle—than the vegetative cells.

A functional test for maternally inherited cadherin in *Xenopus* shows its importance in cell adhesion at the blastula stage

Janet Heasman¹, Dorit Ginsberg², Benjamin Geiger², Kim Goldstone¹, Travis Pratt¹, Chikako Yoshida-Noro¹ and Chris Wylie¹

(A)

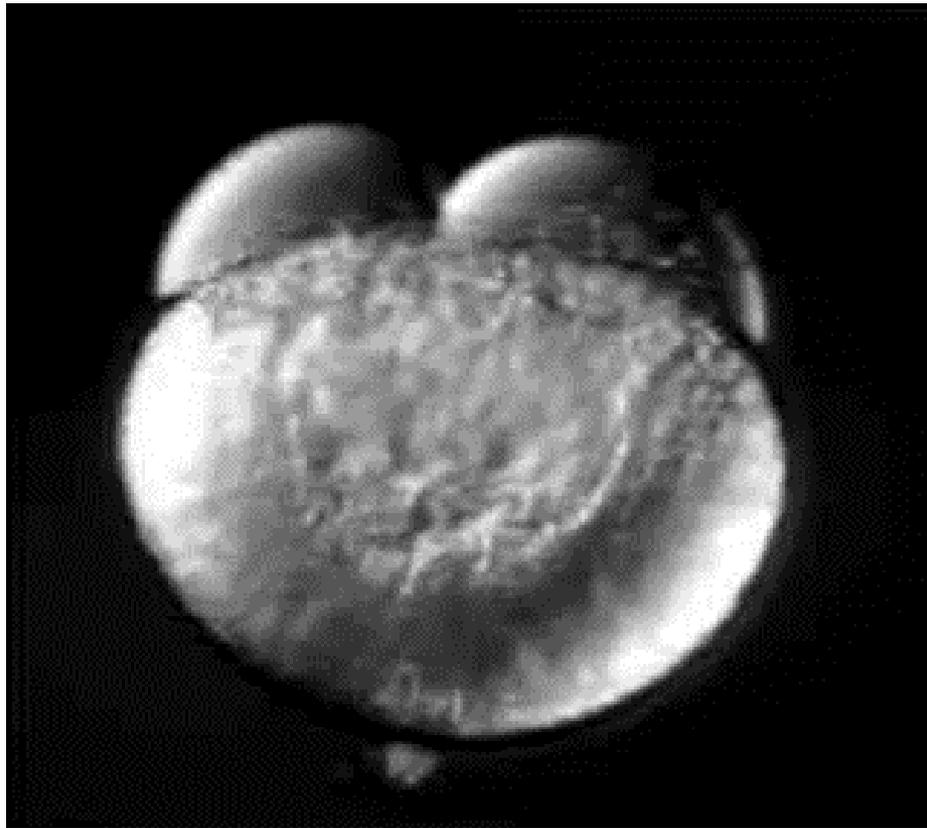


(B)



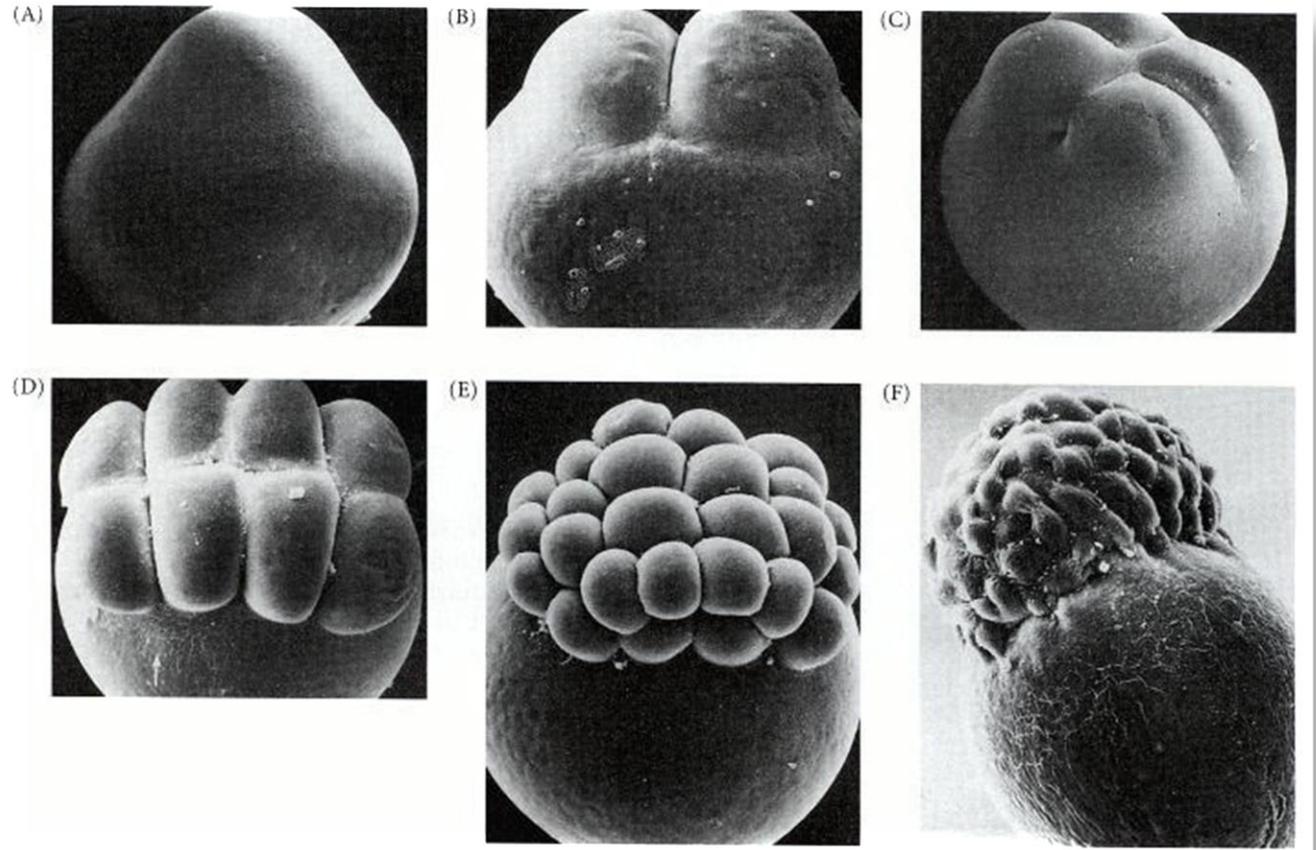
EP-Cadherina

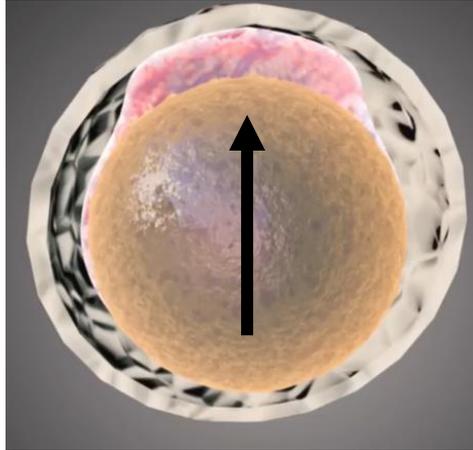
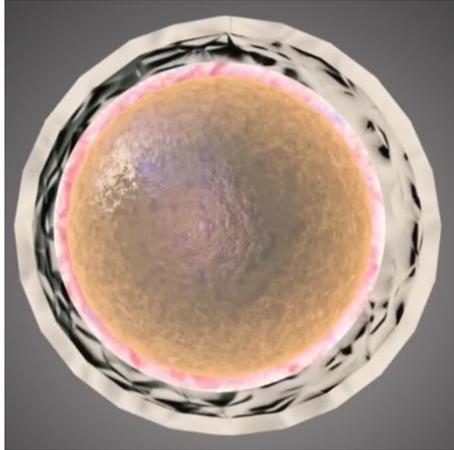
Clivaje meroblástico discoidal: peces teleósteos



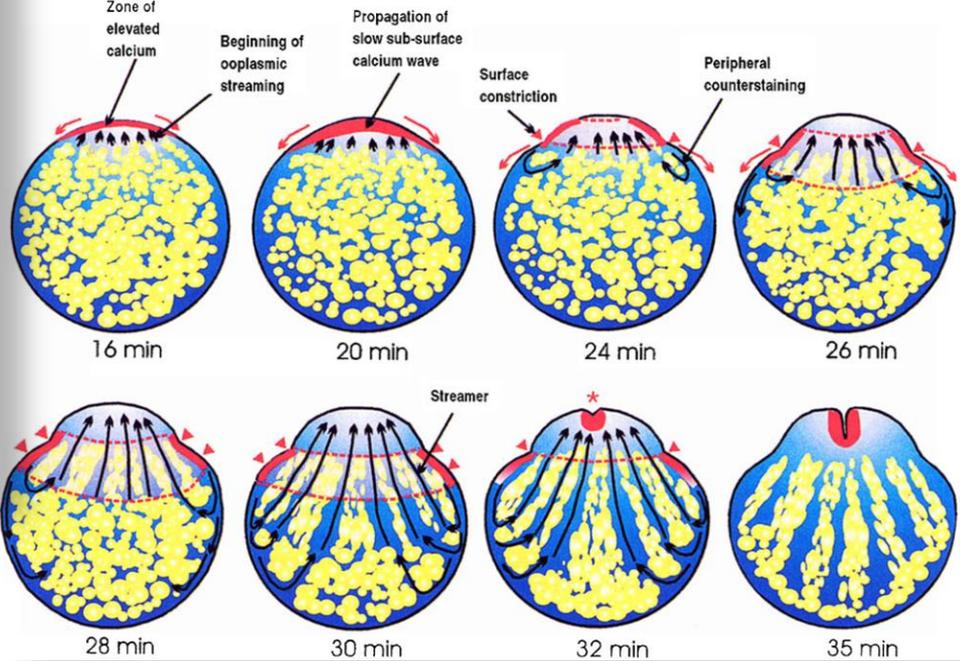
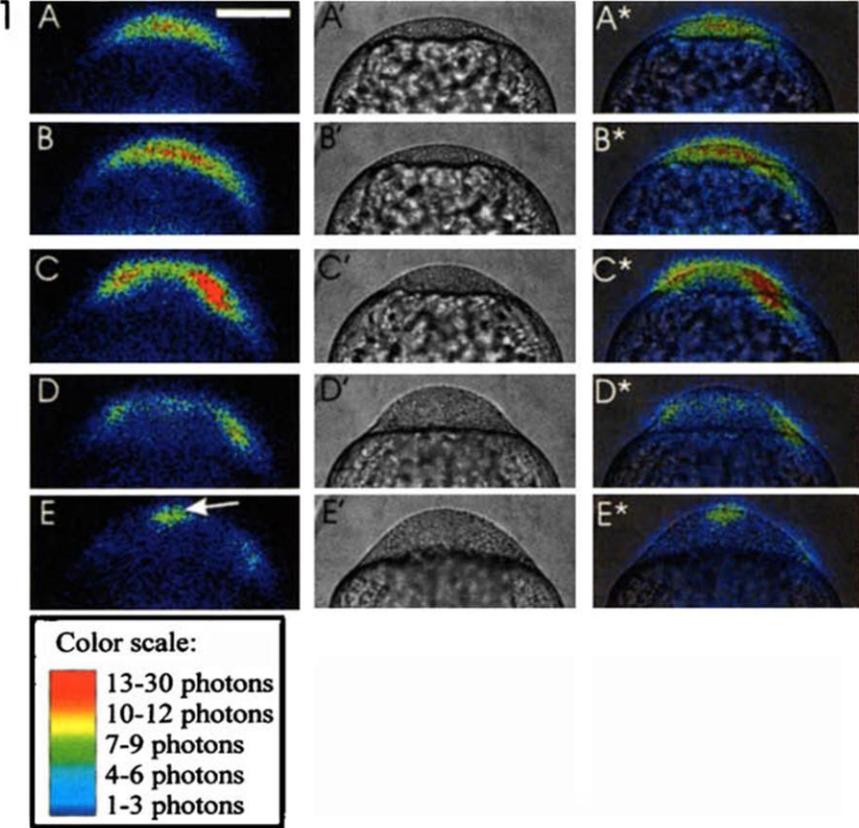
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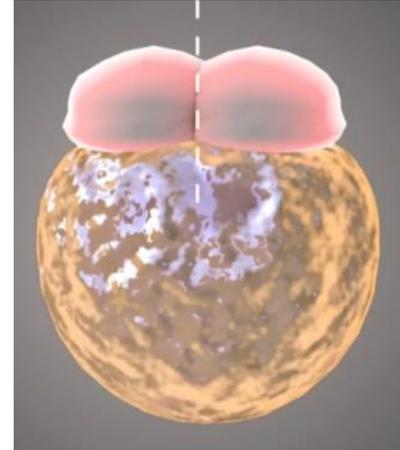
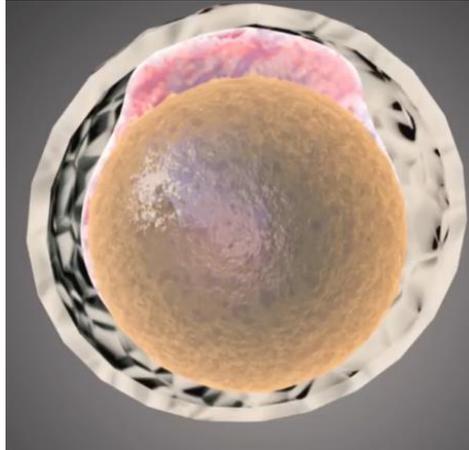
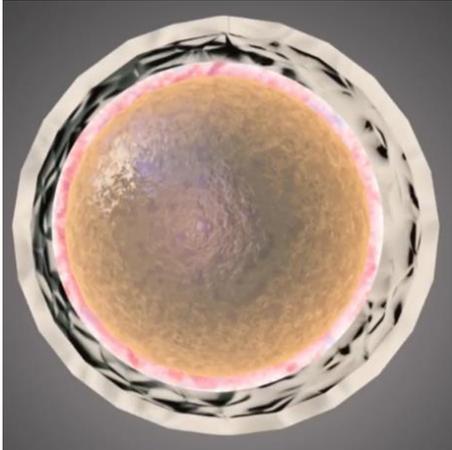
Huevo
telolecito



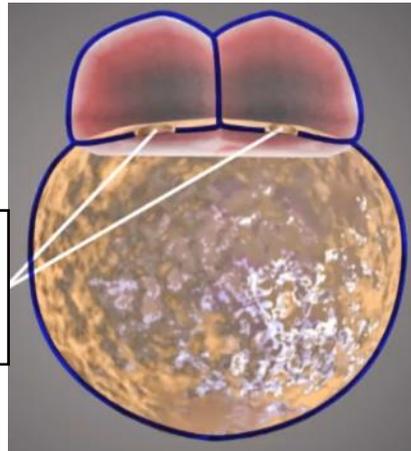


Segregación del oosplasma: formación del blastodisco





Puentes
citoplásmicos

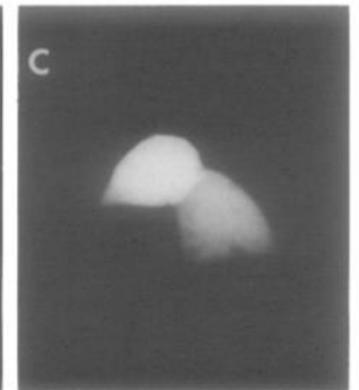
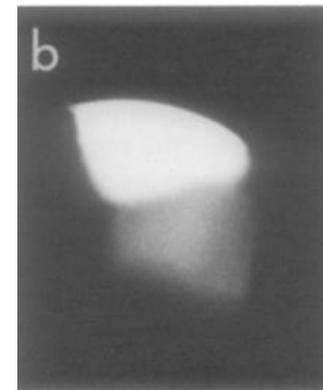
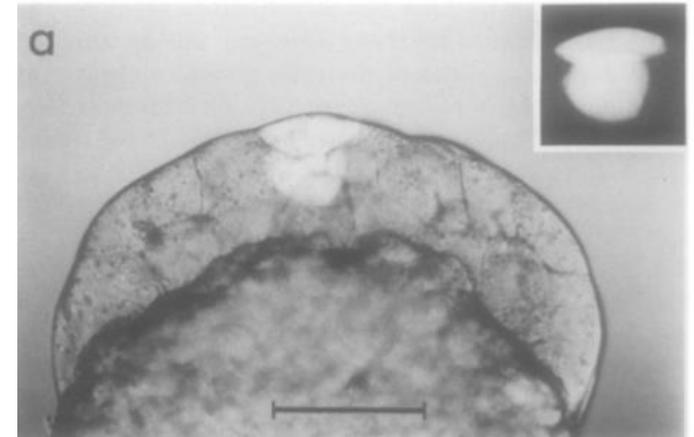
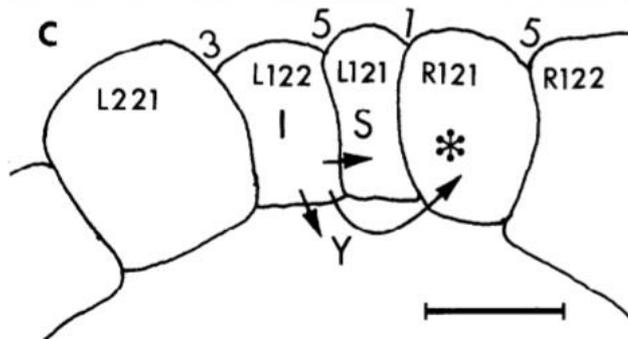
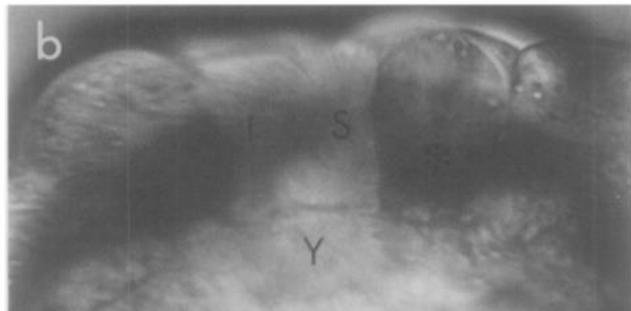
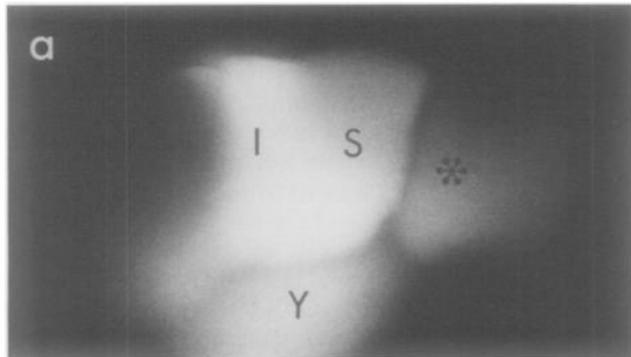


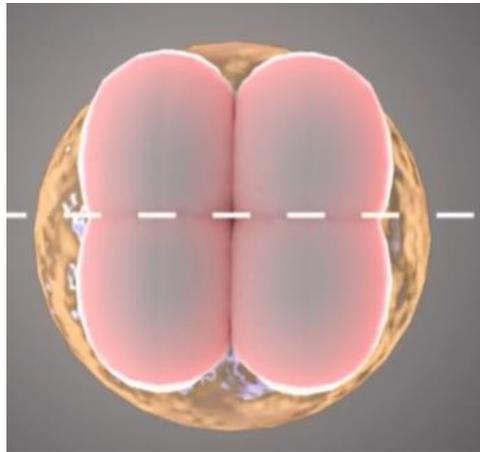
Cell Lineage of Zebrafish Blastomeres¹

I. Cleavage Pattern and Cytoplasmic Bridges between Cells

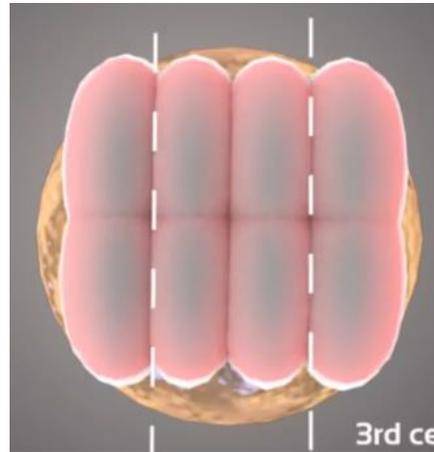
CHARLES B. KIMMEL AND ROBERT D. LAW

Institute of Neuroscience, University of Oregon, Eugene, Oregon 97403

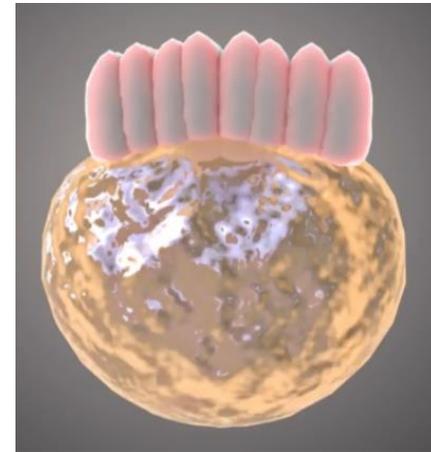




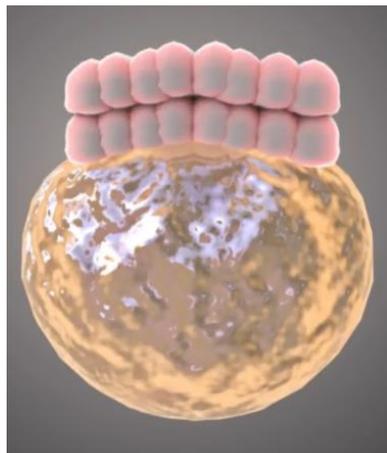
4 células



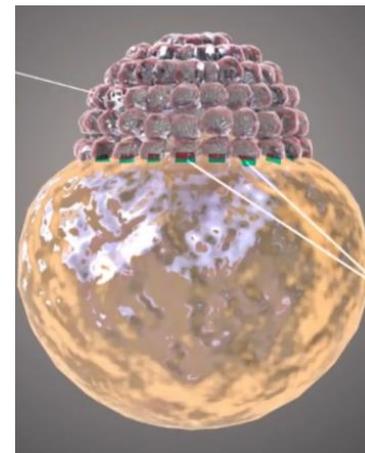
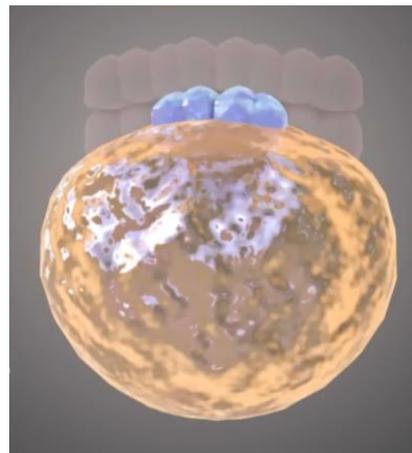
8 células



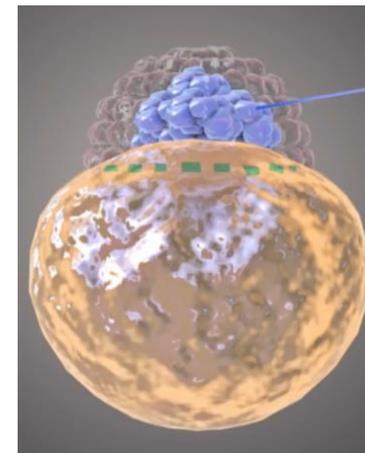
32 células



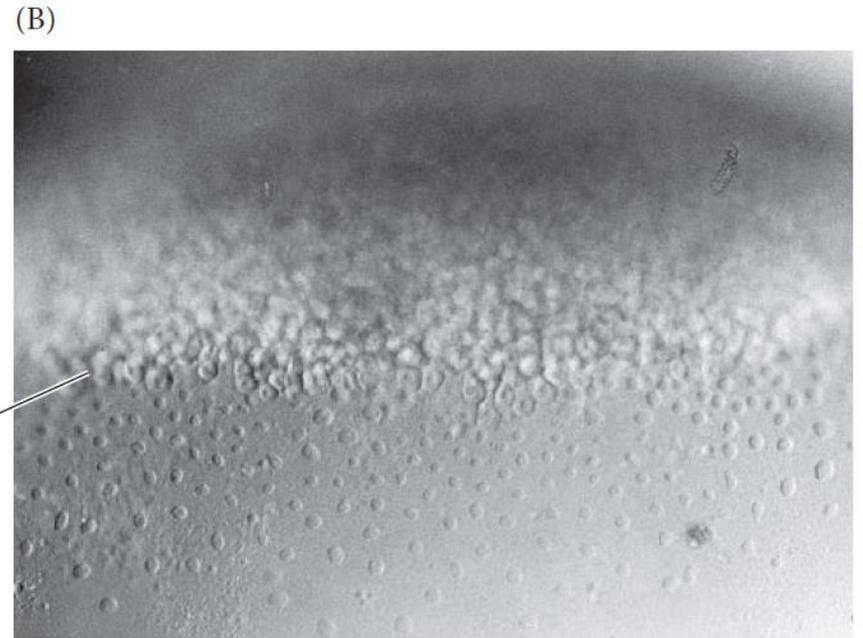
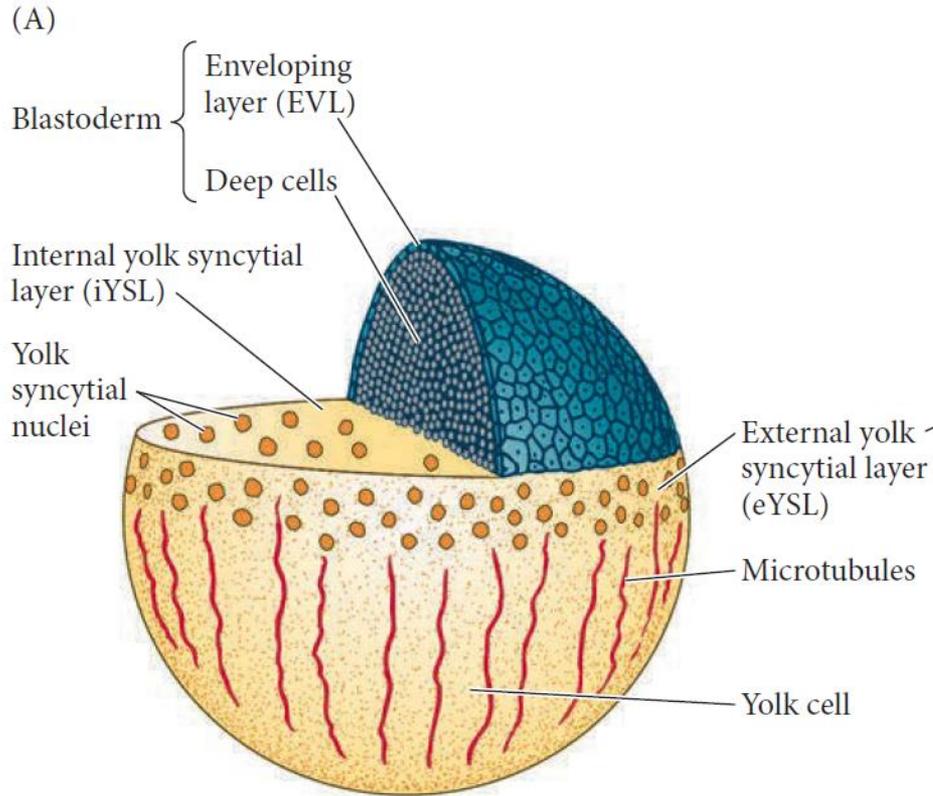
64 células



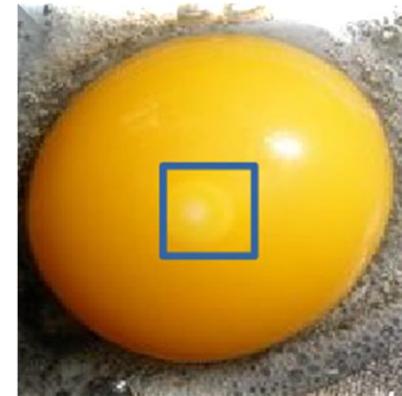
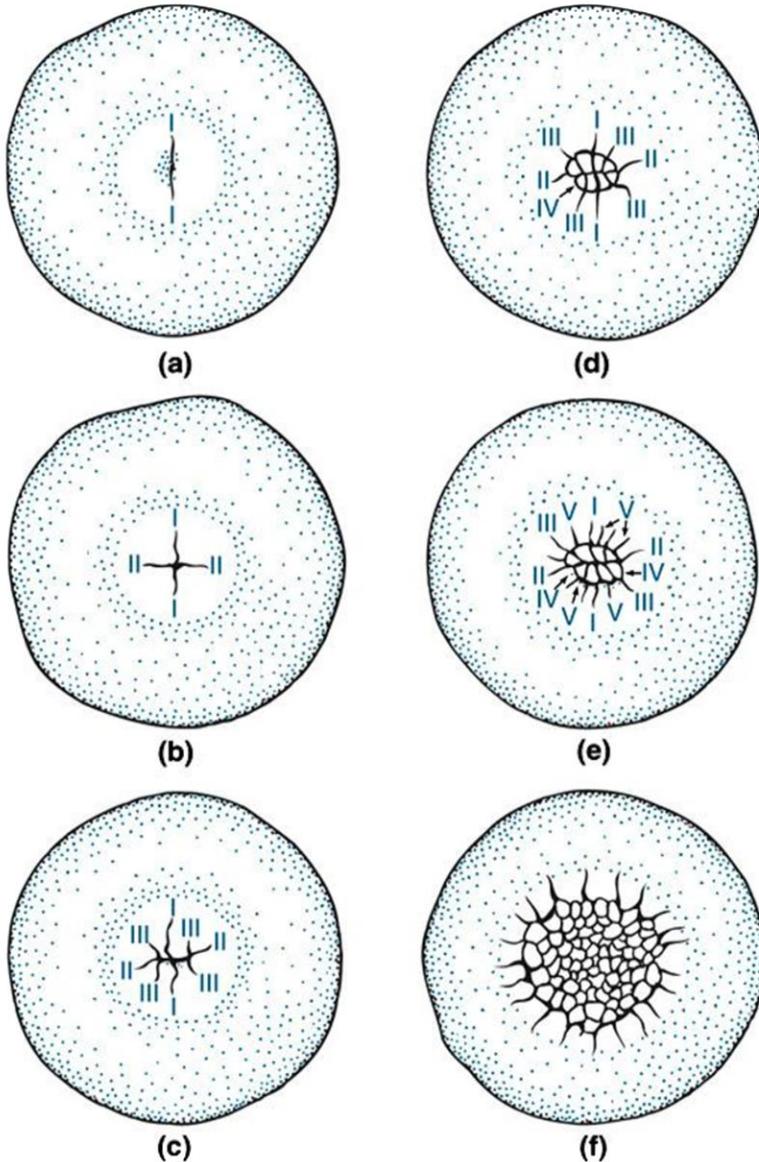
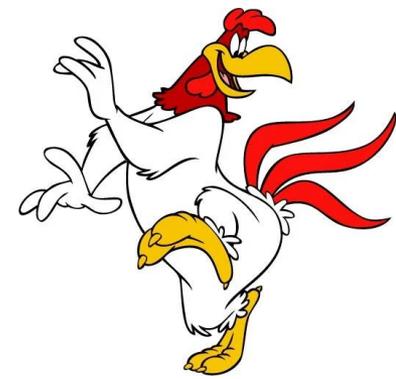
128 células



Células profundas



Clivaje meroblástico discoidal: aves



2-3mm

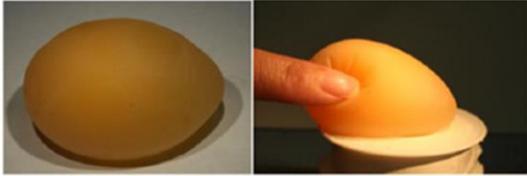
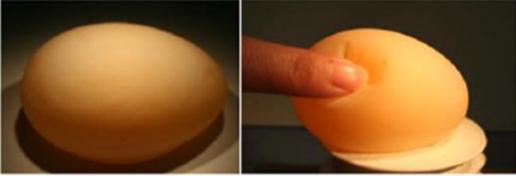
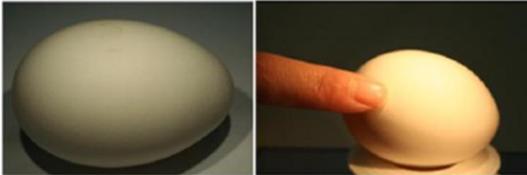
Cleavage Events and Sperm Dynamics in Chick Intrauterine Embryos

Hyung Chul Lee¹, Hee Jung Choi¹, Tae Sub Park¹, Sang In Lee¹, Young Min Kim¹, Deivendran Rengaraj¹, Hiroki Nagai², Guojun Sheng², Jeong Mook Lim¹, Jae Yong Han^{1*}

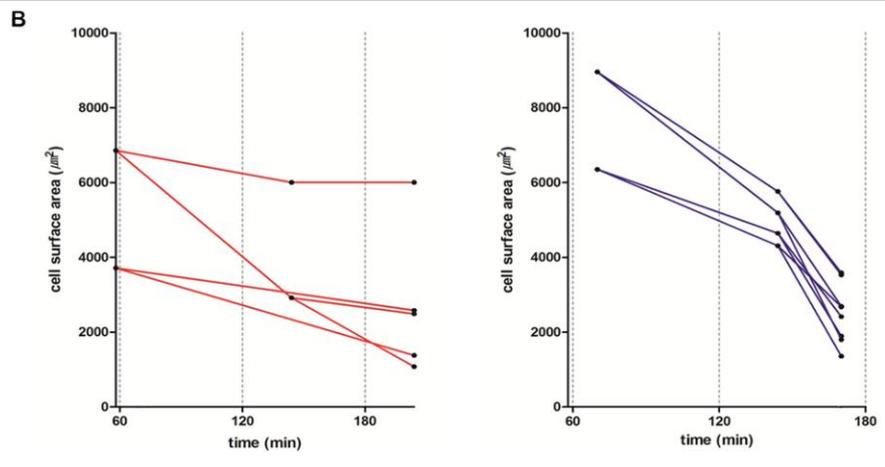
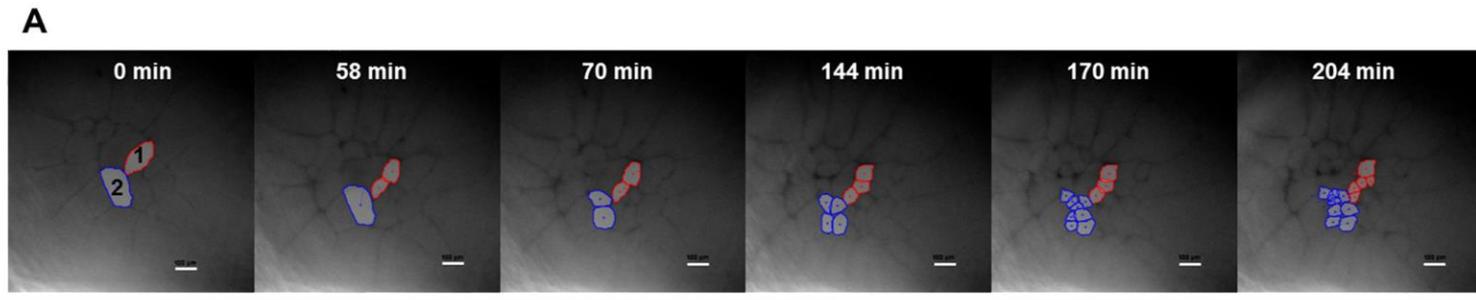
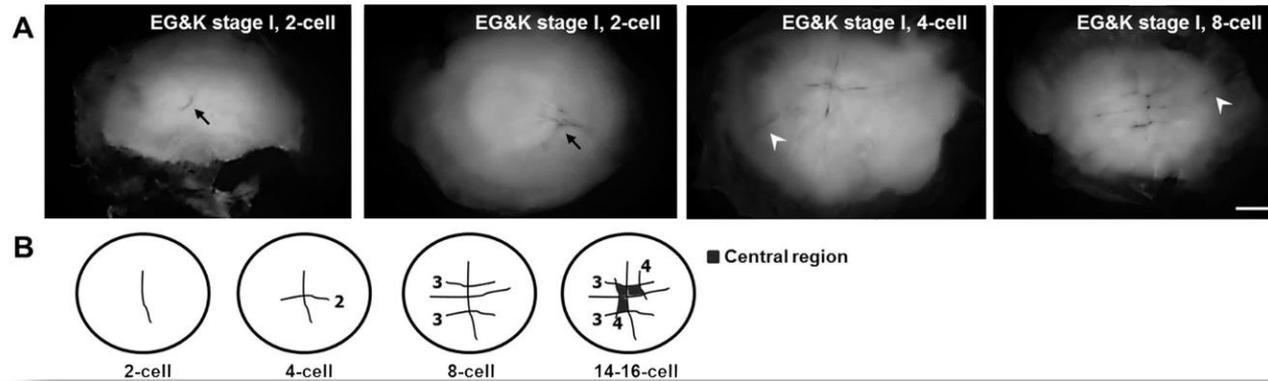
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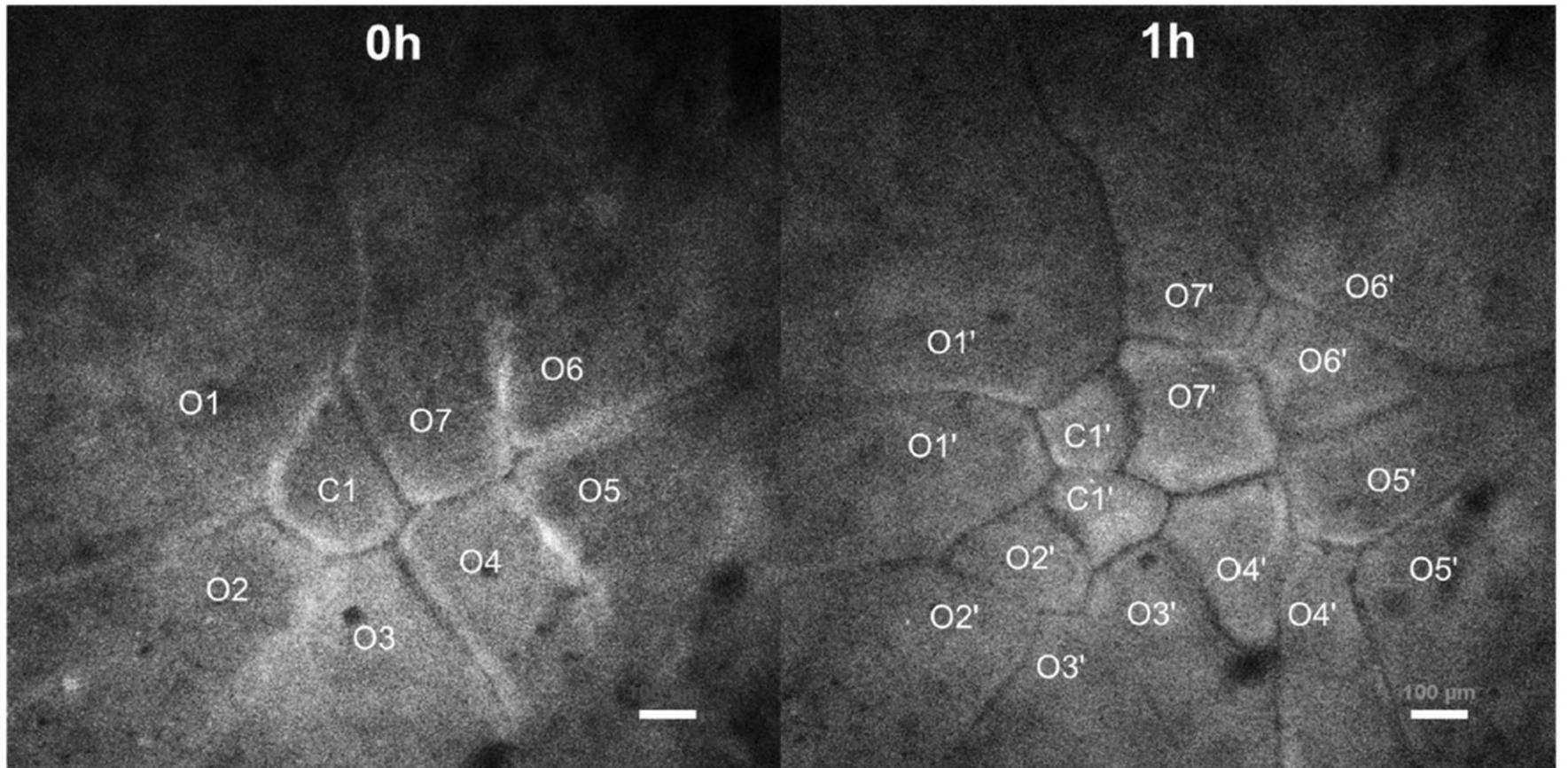


B

Duration in Shell gland	Eggshell formation	Embryo development
0h Eggshell formation Phase I	Yellowish soft eggshell membrane (Initiation of calcium deposition) 	EG&K stage I-V (1-3,000 cells)
8h Eggshell formation Phase II	Light yellowish flexible eggshell (Active calcium deposition) 	EG&K stage V-VII (3,000-30,000 cells)
12h Eggshell formation Phase III (laying) 20h	Milky white stiffened eggshell (Completion of calcium deposition) 	EG&K stage VII-X (30,000-60,000 cells)

Divisiones asimétricas y asincrónicas





RESEARCH REPORT

Cellular analysis of cleavage-stage chick embryos reveals hidden conservation in vertebrate early development

Hiroki Nagai¹, Maiko Sezaki¹, Kisa Kakiguchi², Yukiko Nakaya¹, Hyung Chul Lee³, Raj Ladher⁴, Tomohiro Sasanami⁵, Jae Yong Han³, Shigenobu Yonemura² and Guojun Sheng^{1,*}



~300 células

