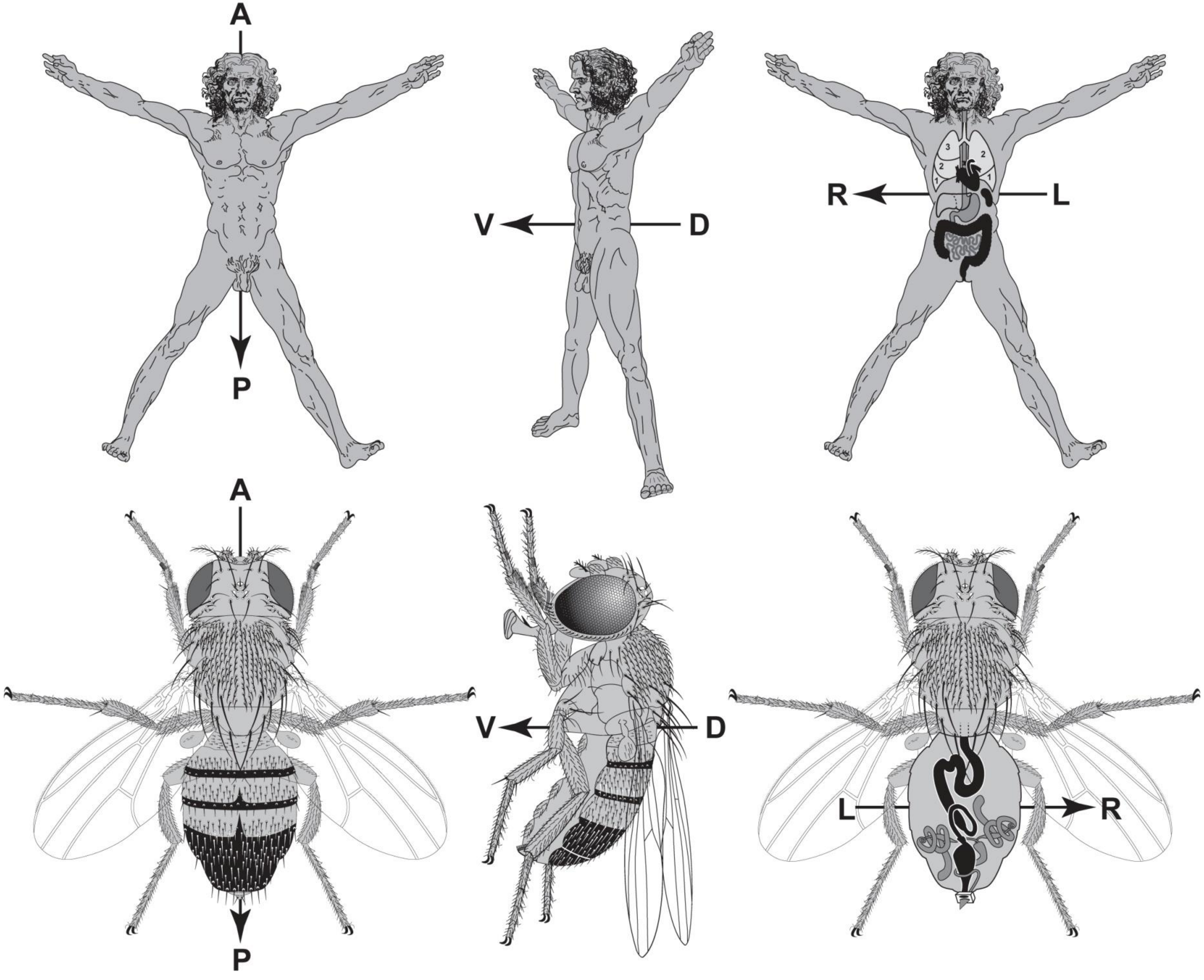
A
P
V
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3
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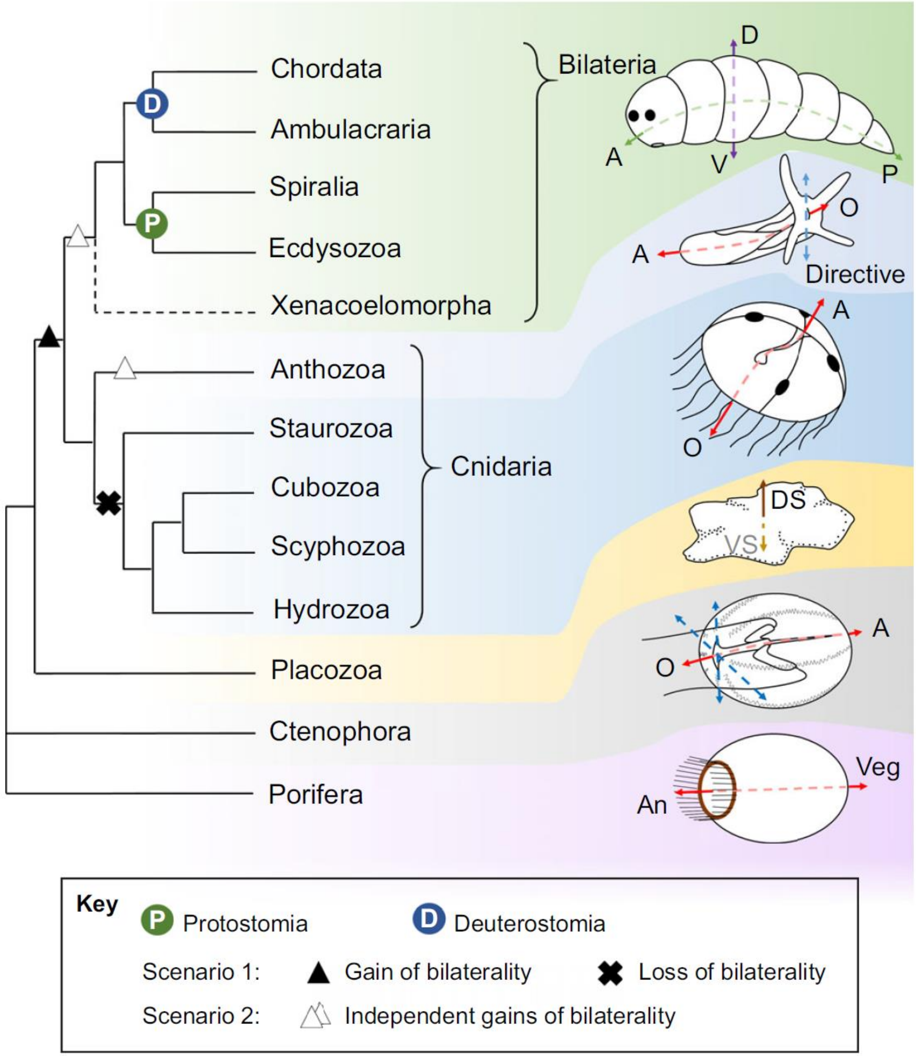
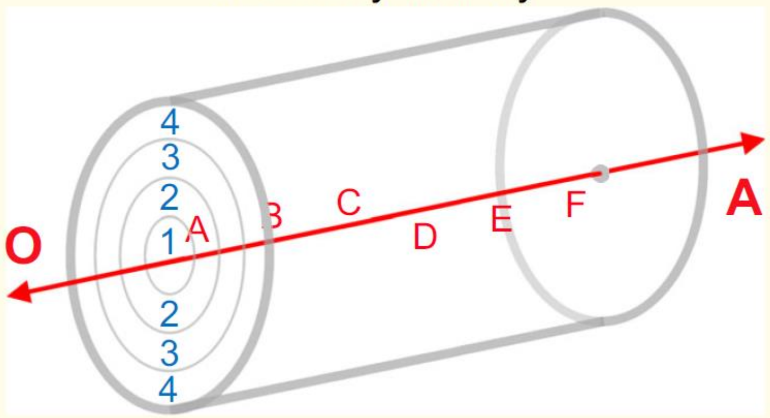


Fig. 1. The distribution of different body symmetries among animals. Alternative scenarios that can explain the emergence of bilaterality are depicted. An-Veg, animal-vegetal; DS-VS, dorsal surface-ventral surface; O-A, oral-aboral; A-P, anterior-posterior; D-V, dorsal-ventral.

Genikhovich 2017

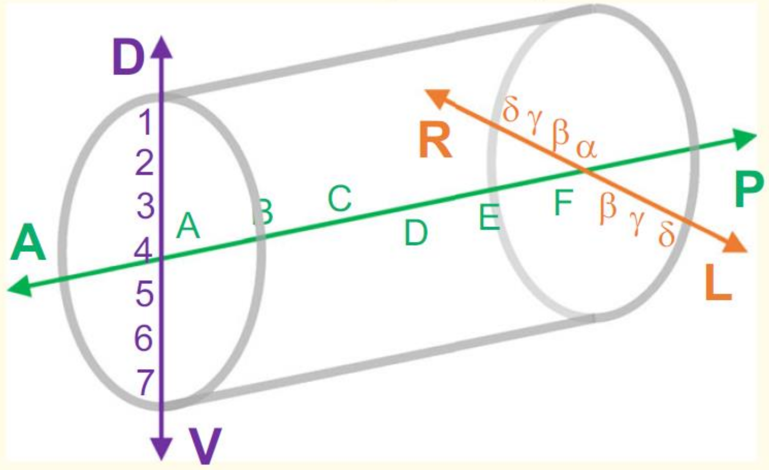
Box 2. Bilaterality and the diversification of body plans

Radial symmetry



6 × 4 = 24 unique coordinates

Bilateral symmetry



6 × 7 × 4 = 168 unique coordinates

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Eje Antero-posterior

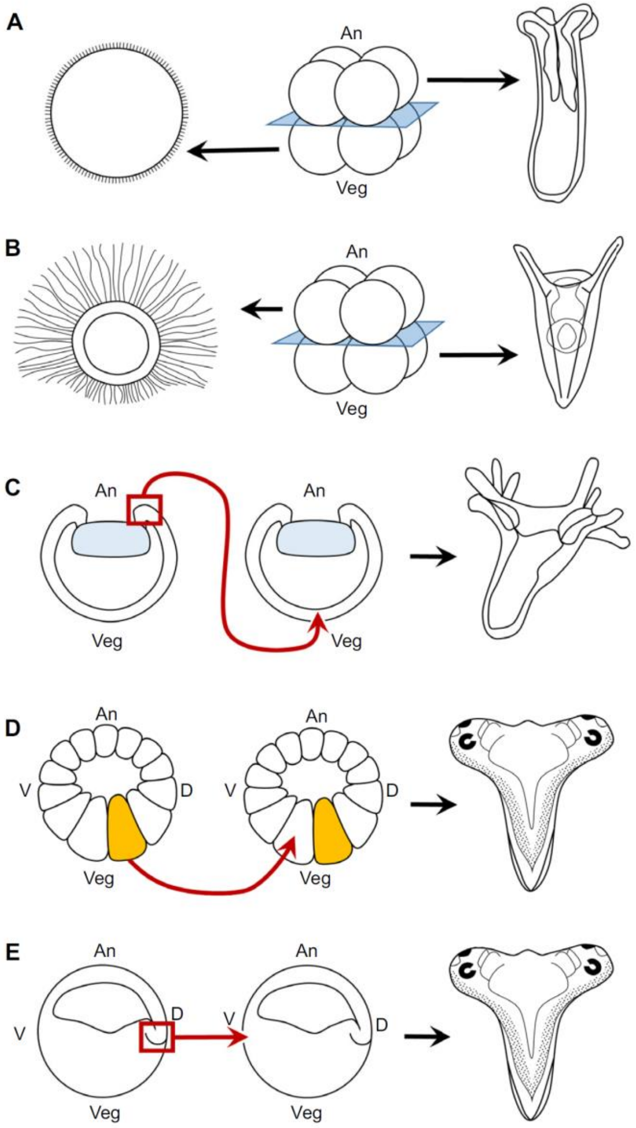

Fig. 3. β-Catenin signalling-dependent axial organizer capacity. (A,B) Bisection experiments in *Nematostella* (A) and sea urchin (B) demonstrate the presence of axial determinants in the cytoplasm inherited by cells giving rise to the gastrulation pole. For both *Nematostella* and the sea urchin, a primary polyp (A) or a pluteus larva (B) with normal body axes develops from only the half of the embryo where gastrulation would normally take place. (C,D) Transplantations of the blastopore lip of *Nematostella*, just like transplantations of the amphibian Nieuwkoop centre (D) or Spemann-Mangold organizer (E) into a ventral position, result in the formation of the Siamese twin embryos. An, animal pole; Veg, vegetal pole; D, dorsal; V, ventral.

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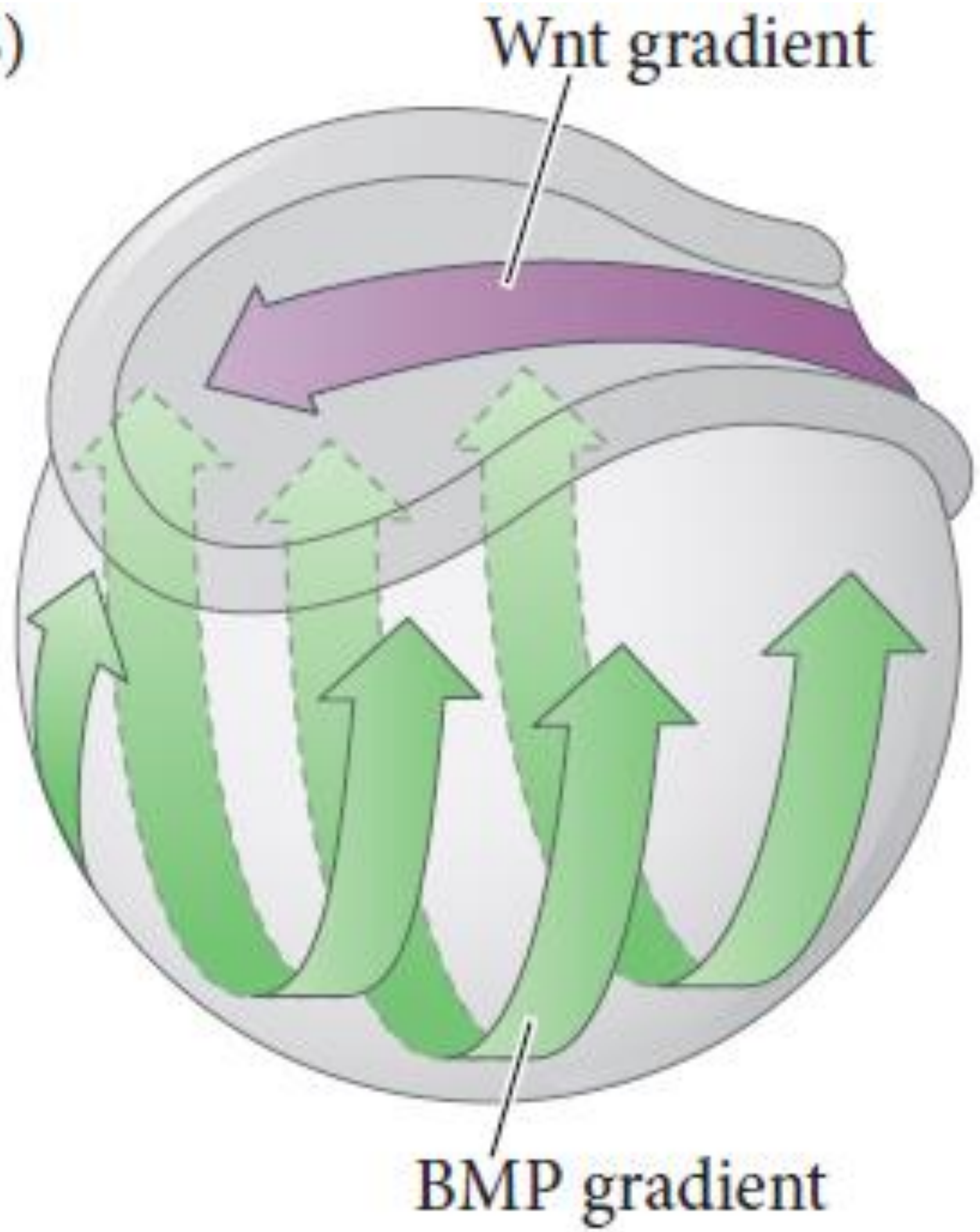
(B)



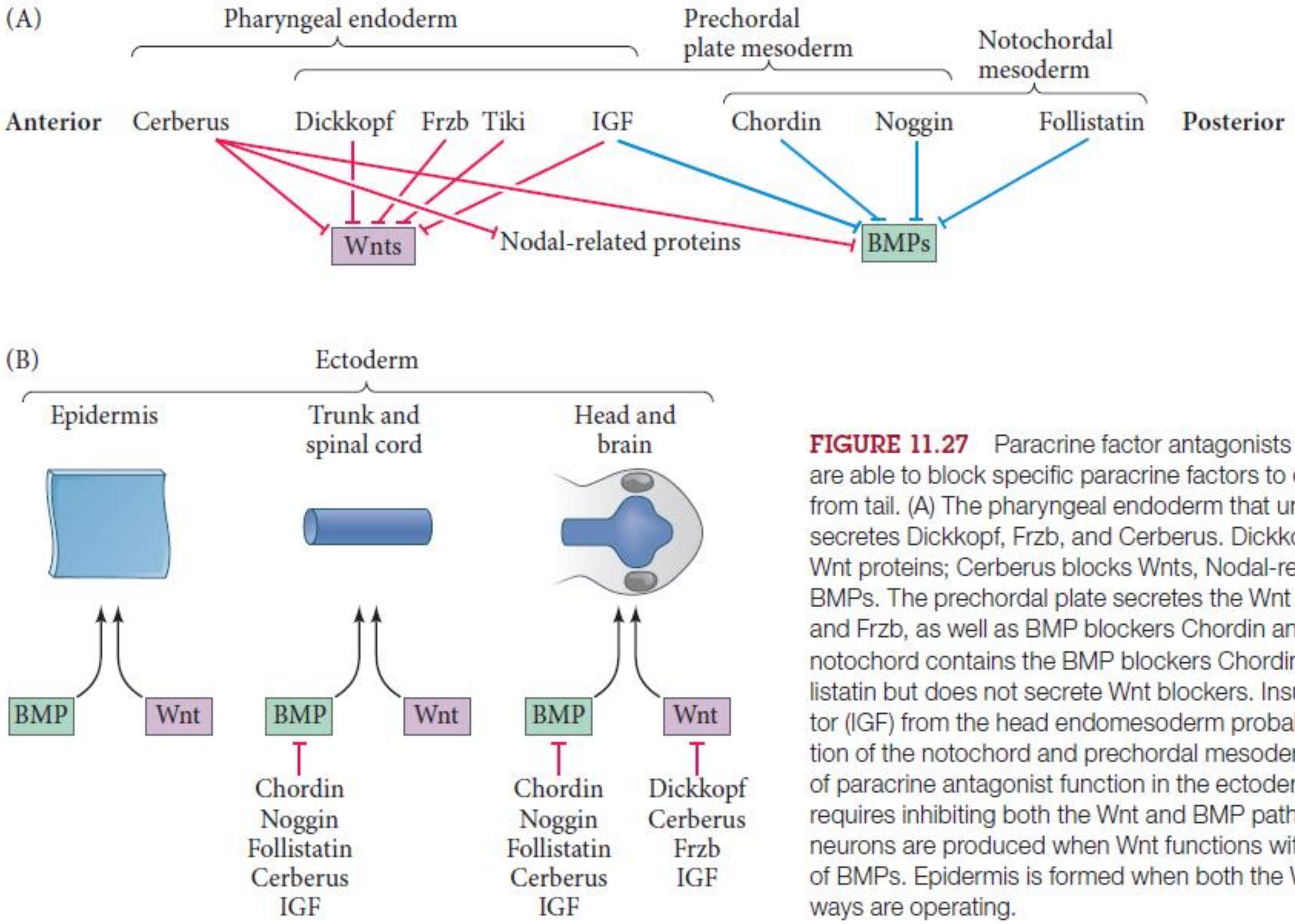
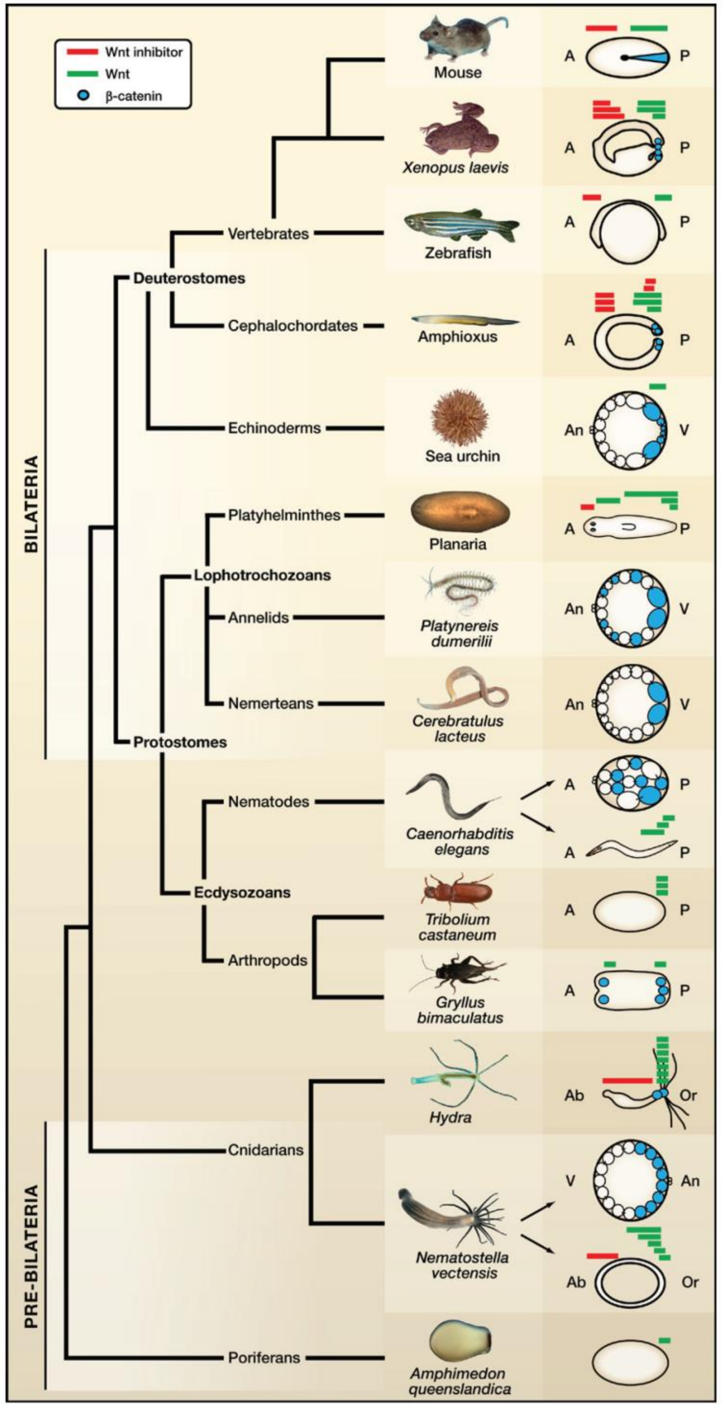
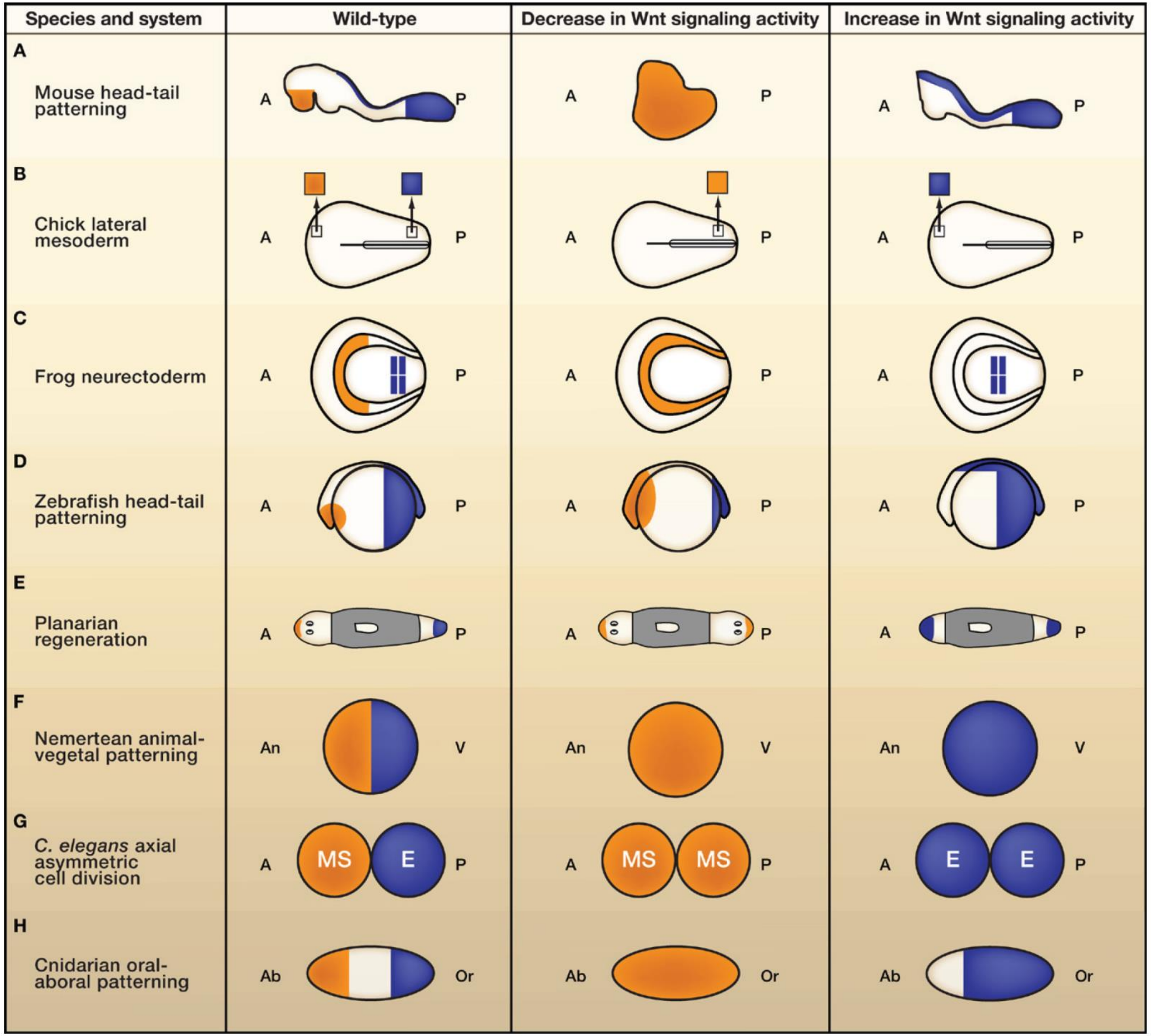


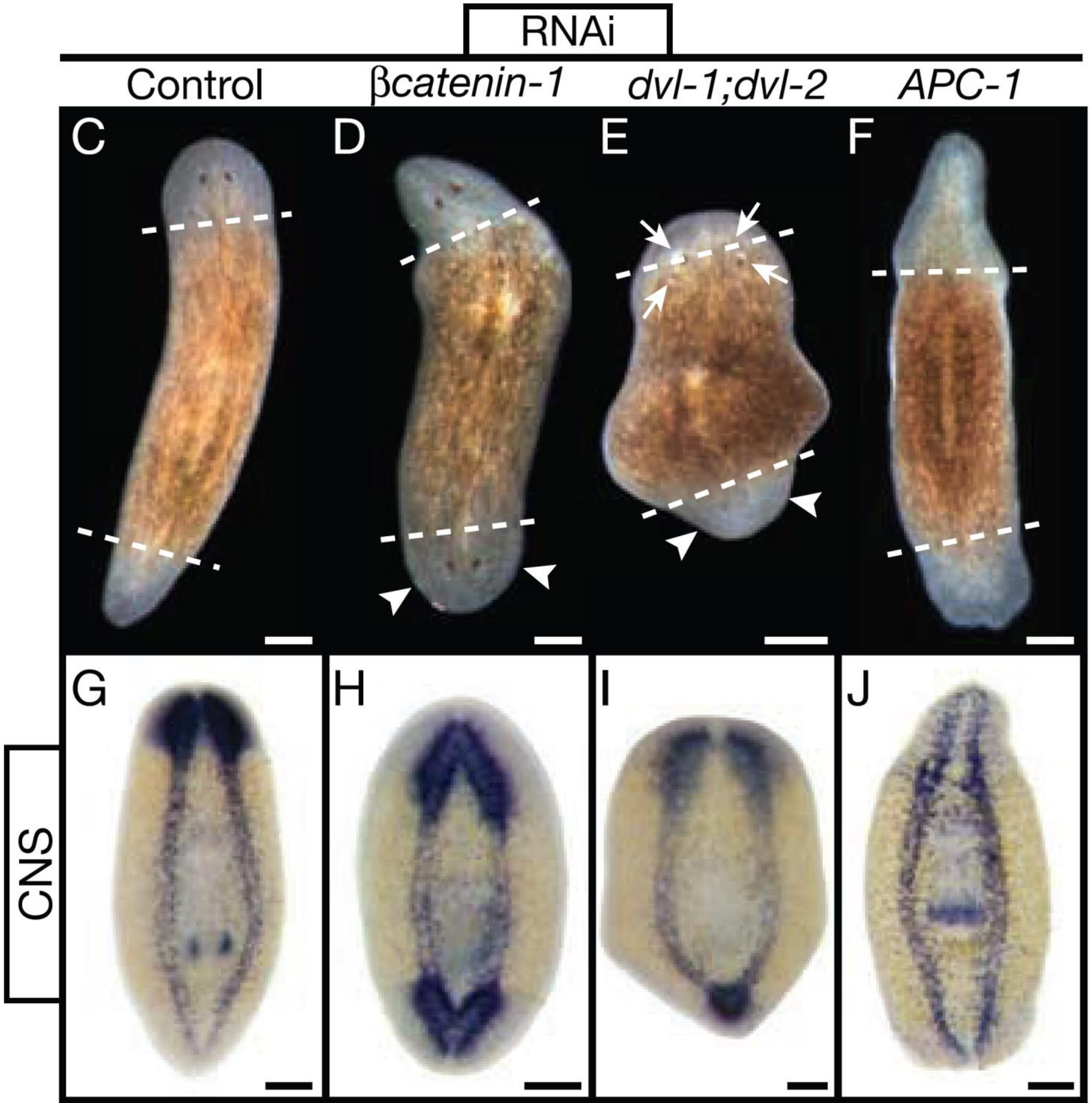
FIGURE 11.27 Paracrine factor antagonists from the organizer are able to block specific paracrine factors to distinguish head from tail. (A) The pharyngeal endoderm that underlies the head secretes Dickkopf, Frzb, and Cerberus. Dickkopf and Frzb block Wnt proteins; Cerberus blocks Wnts, Nodal-related proteins, and BMPs. The prechordal plate secretes the Wnt blockers Dickkopf and Frzb, as well as BMP blockers Chordin and Noggin. The notochord contains the BMP blockers Chordin, Noggin, and Follistatin but does not secrete Wnt blockers. Insulin-like growth factor (IGF) from the head endomesoderm probably acts at the junction of the notochord and prechordal mesoderm. (B) Summary of paracrine antagonist function in the ectoderm. Brain formation requires inhibiting both the Wnt and BMP pathways. Spinal cord neurons are produced when Wnt functions without the presence of BMPs. Epidermis is formed when both the Wnt and BMP pathways are operating.

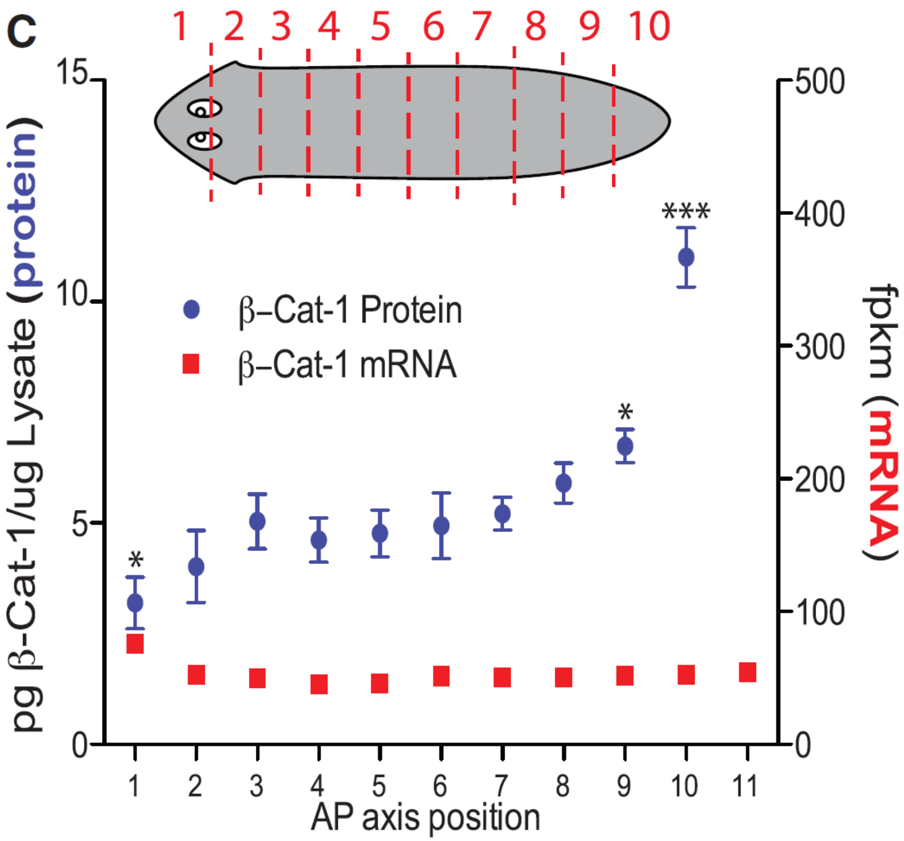


Petersen & Reddien 2009



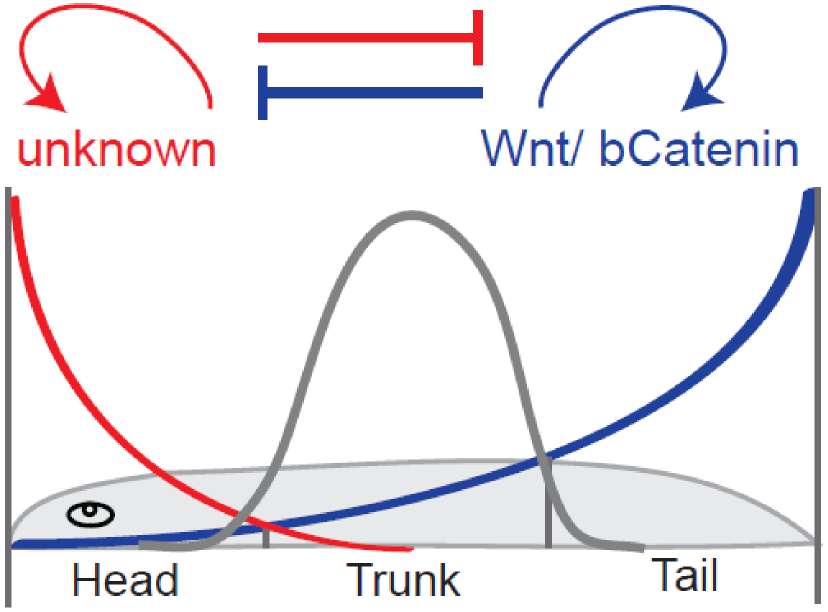
Petersen & Reddien 2009



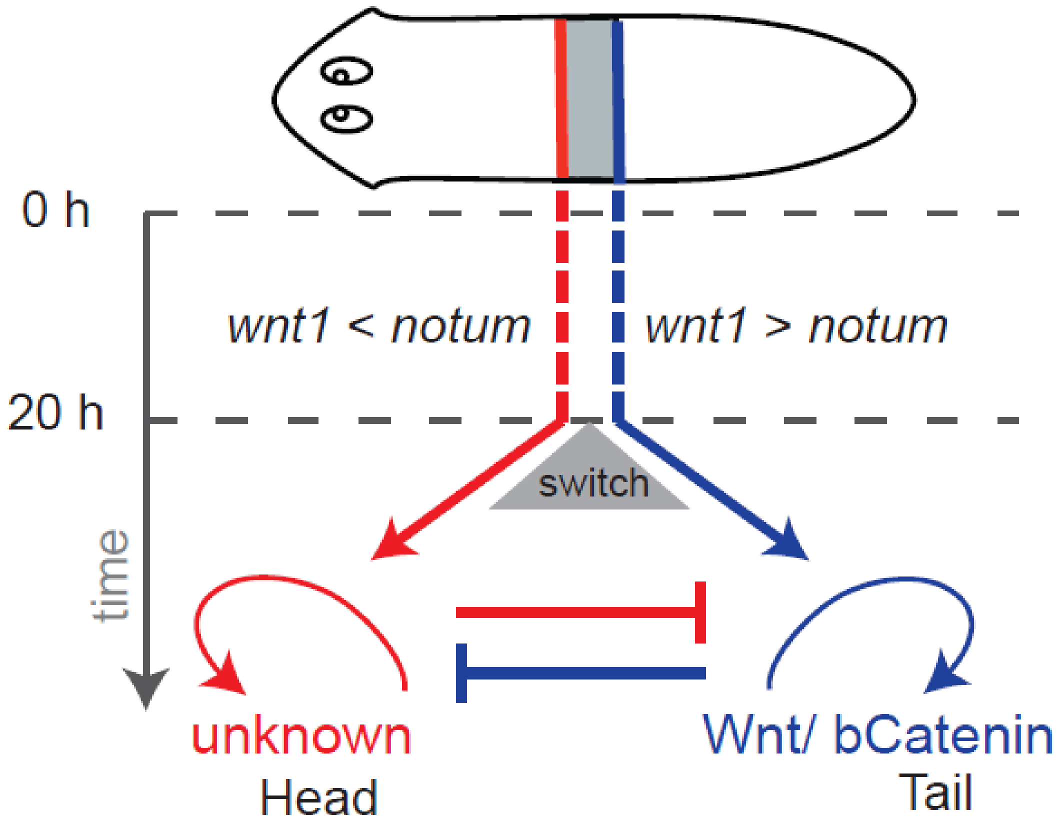


Gurley et al 2008; Stückemann et al 2017

Intact planarian



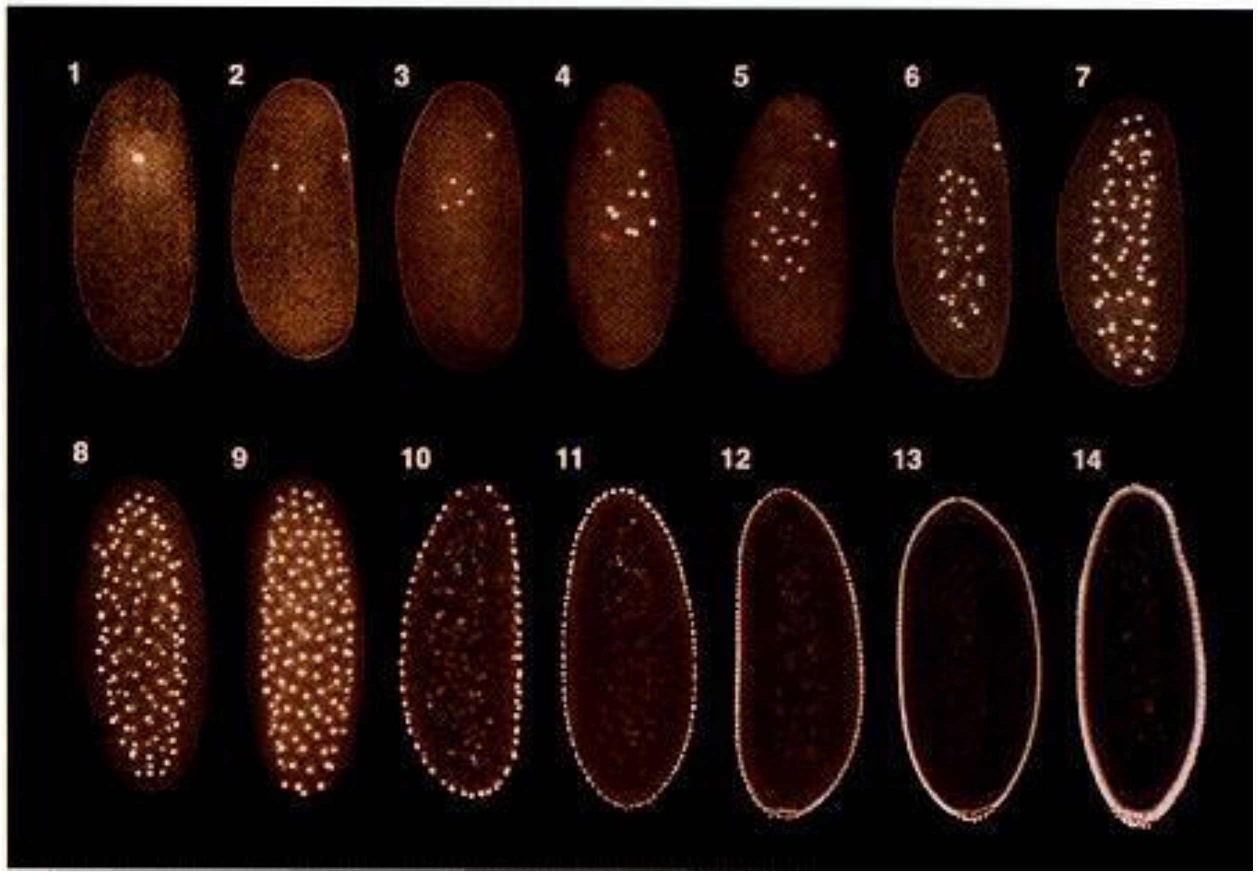
Regenerating planarian

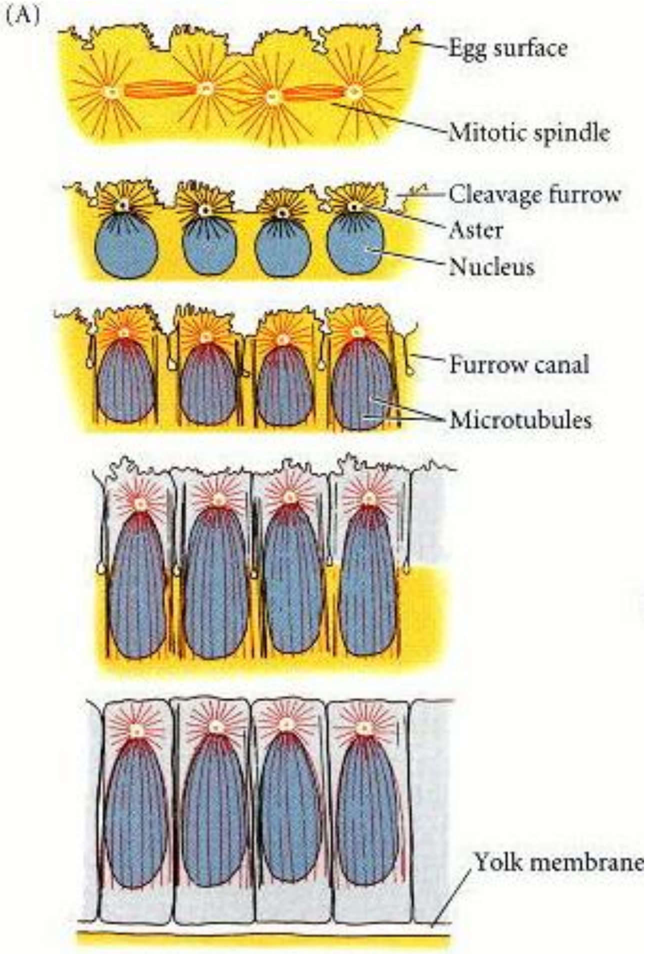


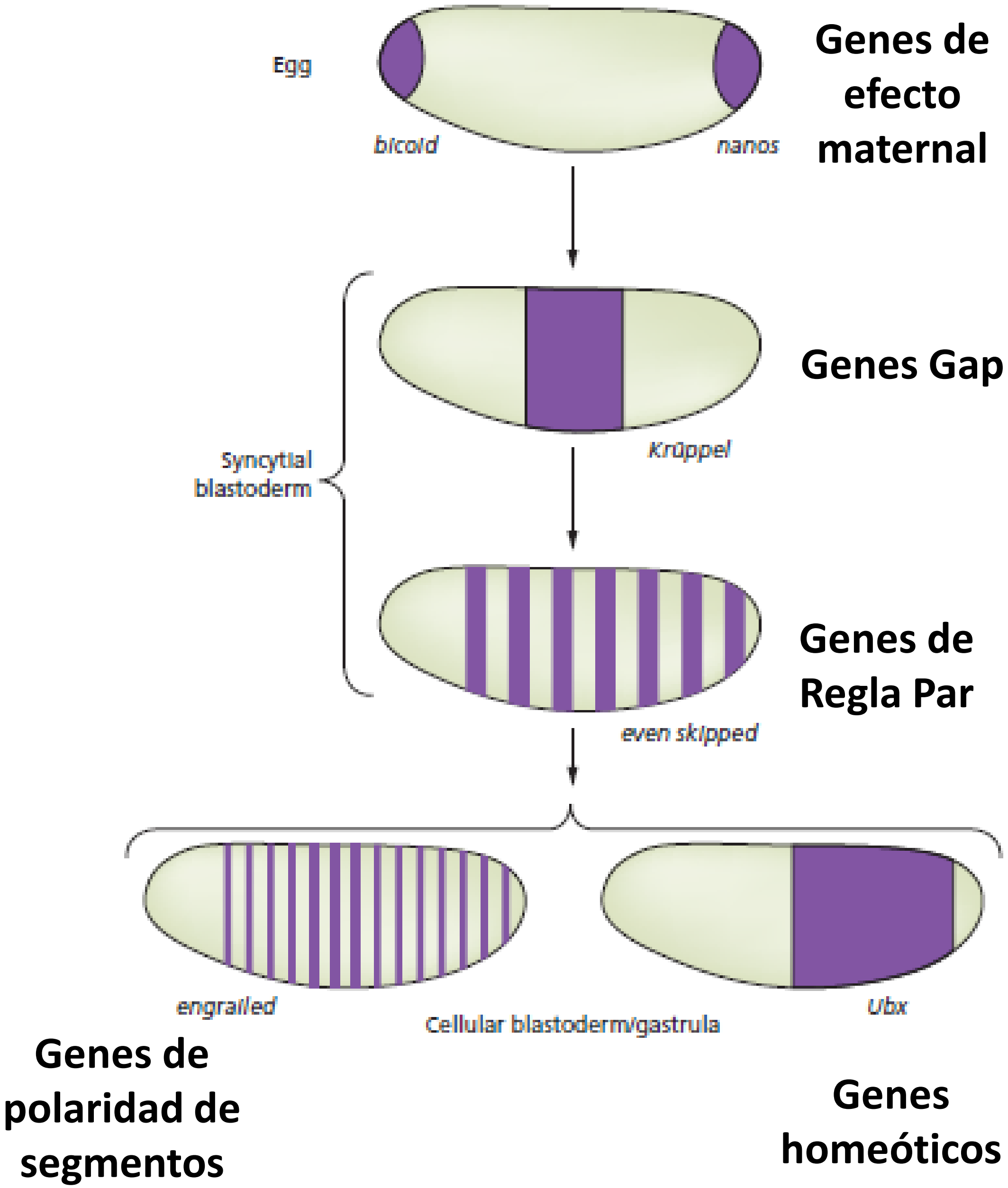
Stückemann et al 2017

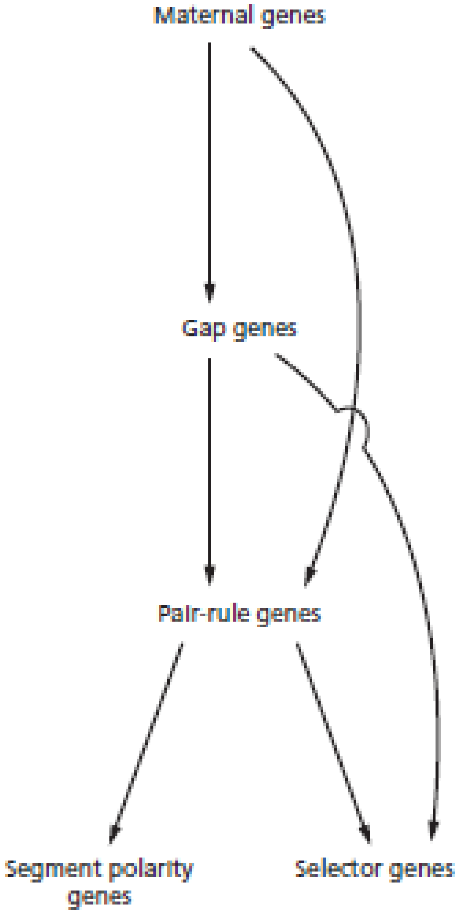
Cascadas regulatorias en el eje AP de *Drosophila*

Organización sincitial del embrión temprano de *Drosophila*



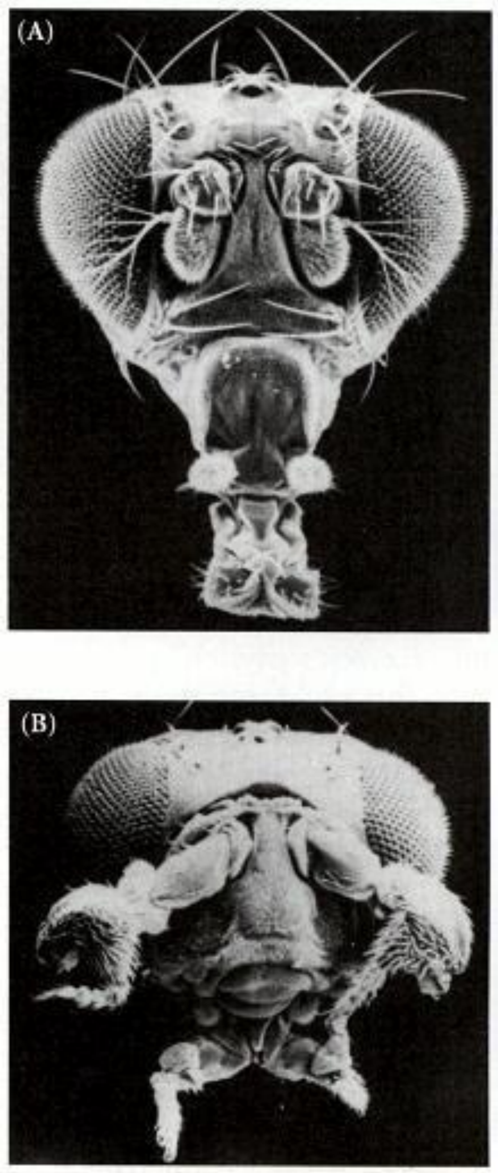




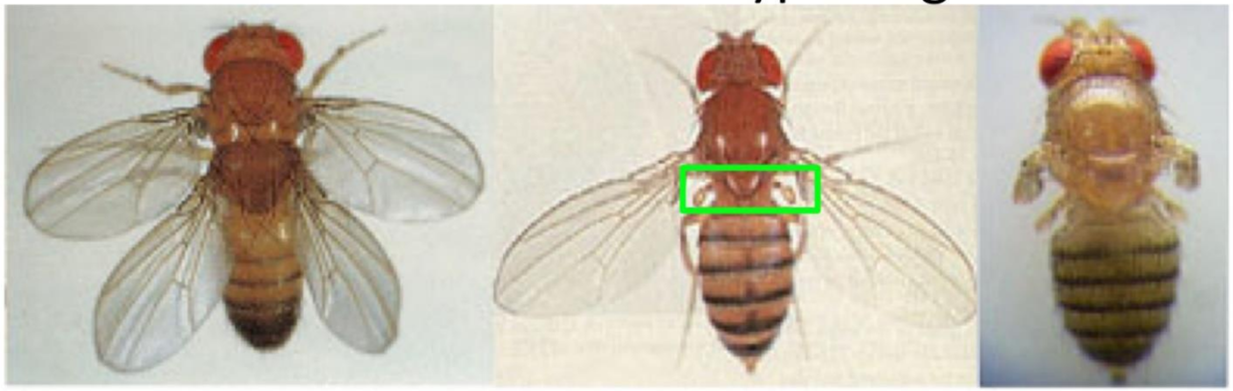


Slack 2006 Essential Developmental Biology

Mutaciones homeóticas

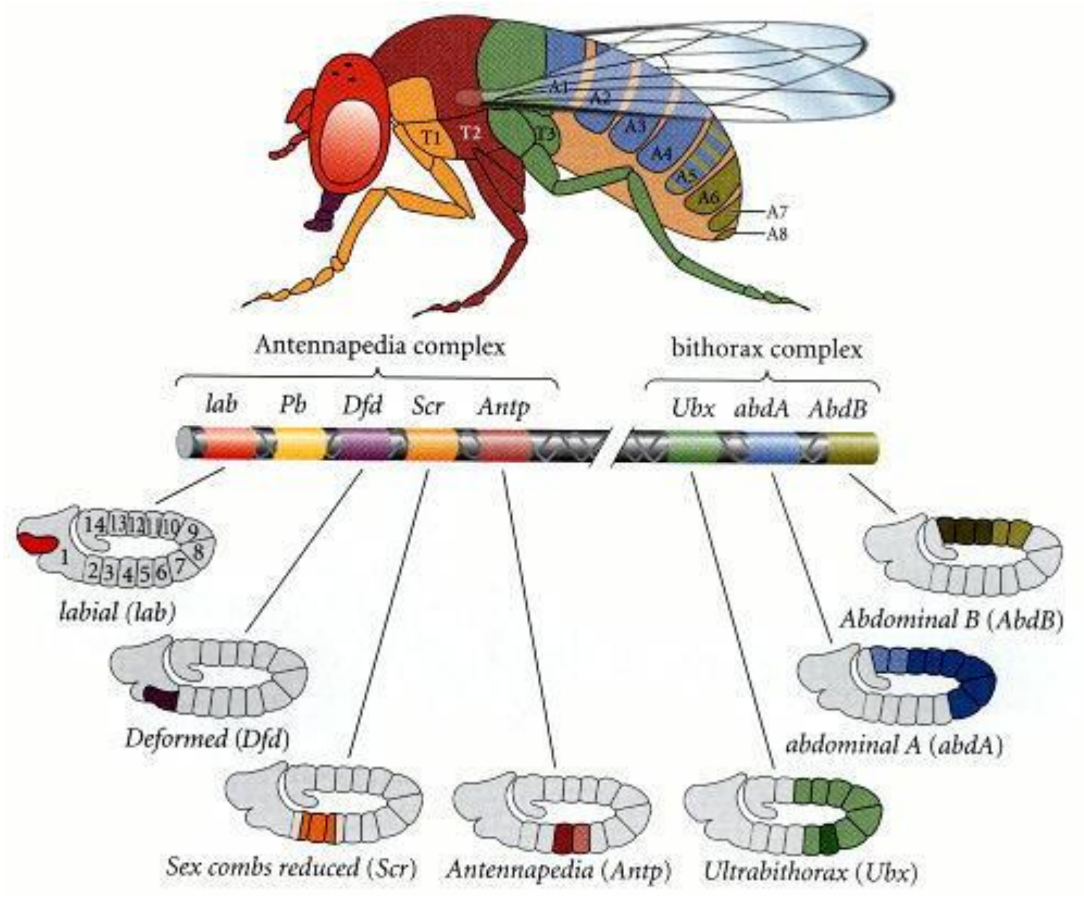


antenapedia



ultrabithorax

Mutaciones homeóticas



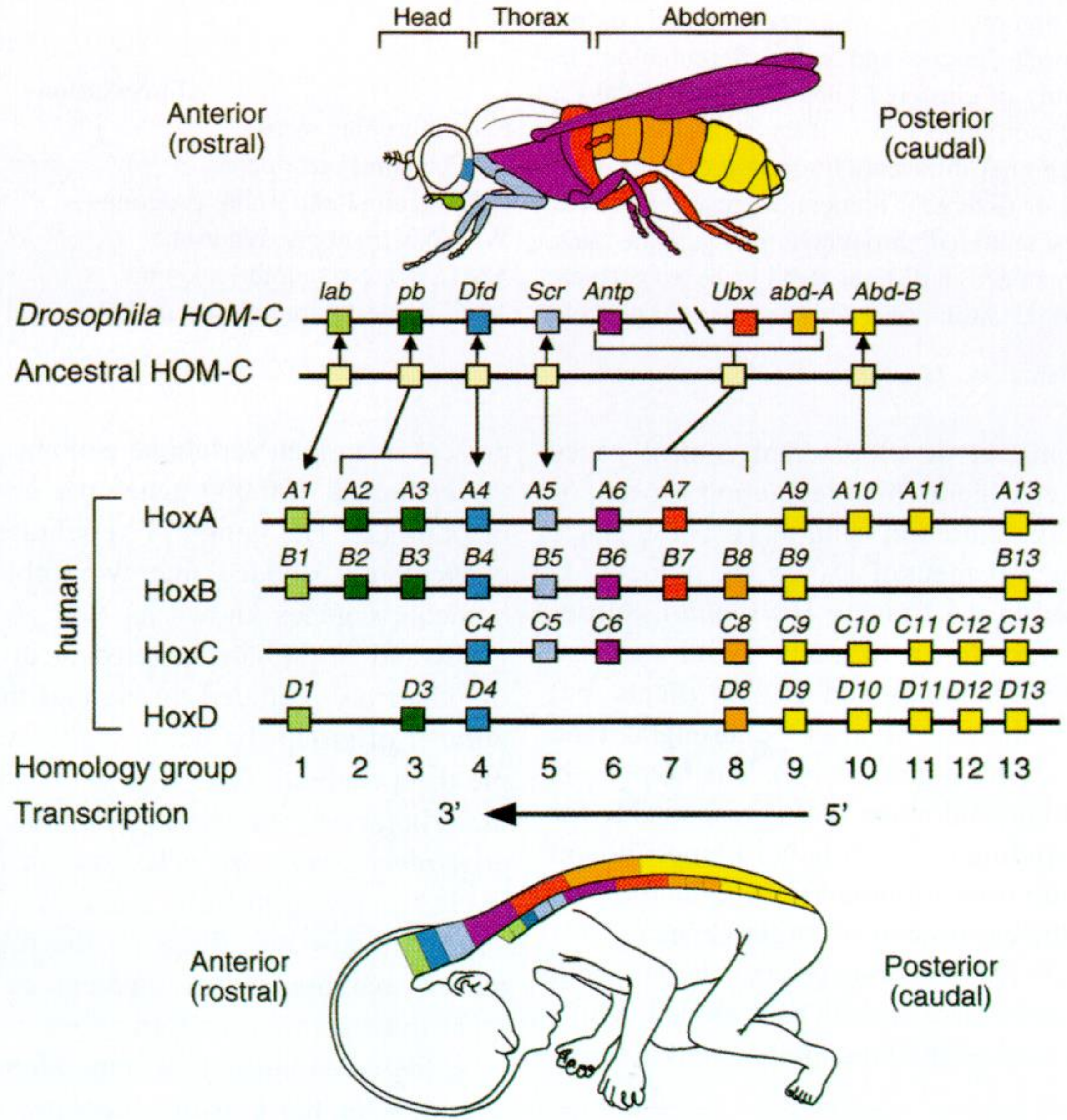
Complejo de genes Hox

- **Factores de transcripción con homeodominio**

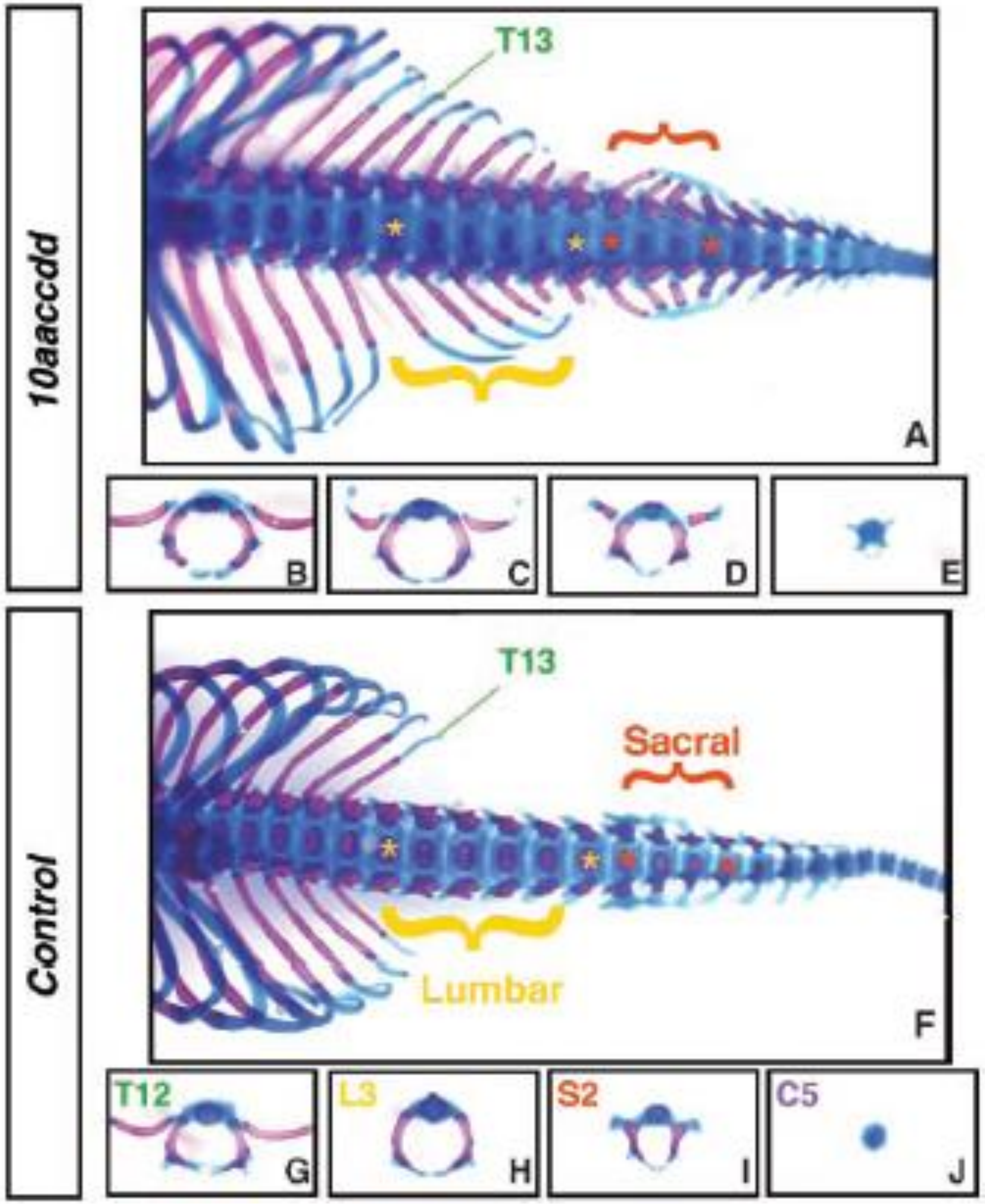
-**Especifican identidad A-P de segmentos**

- **Agrupados en el genoma (Cluster)**

- **Colinearidad entre posición en el complejo y expresión en el embrión!**



Head
Thorax
Abdomen
Anterior (rostral)
Posterior (caudal)
lab
pb
Dfd
Scr
Antp
Ubx
abd-A
Abd-B
Drosophila HOM-C
Ancestral HOM-C
A1 A2 A3 A4 A5 A6 A7 A9 A10 A11 A13
HoxA
B1 B2 B3 B4 B5 B6 B7 B8 B9 B13
HoxB
C4 C5 C6 C8 C9 C10 C11 C12 C13
HoxC
D1 D3 D4 D8 D9 D10 D11 D12 D13
HoxD
human
Homology group 1 2 3 4 5 6 7 8 9 10 11 12 13
Transcription 3' 5'
Anterior (rostral)
Posterior (caudal)



Wellik & Capecchi 2003

Dominios de cromatina
Enhancers compartidos

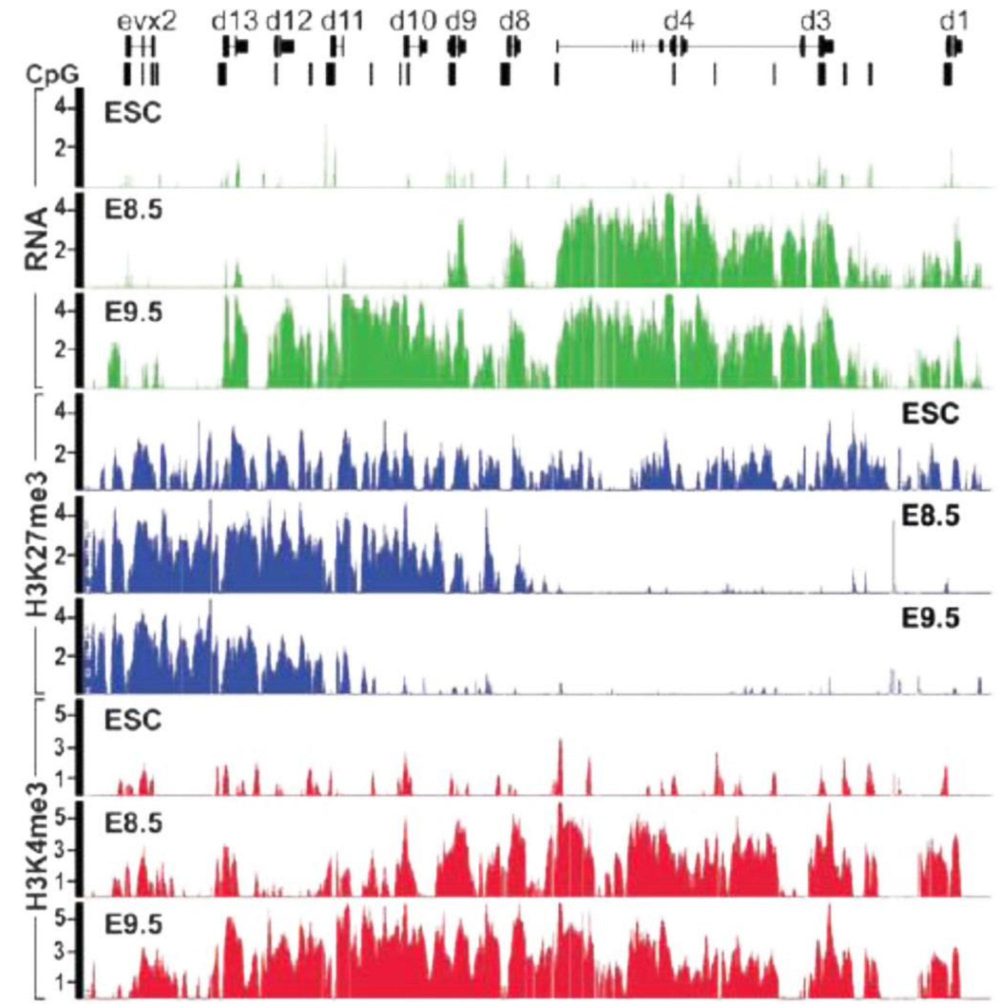
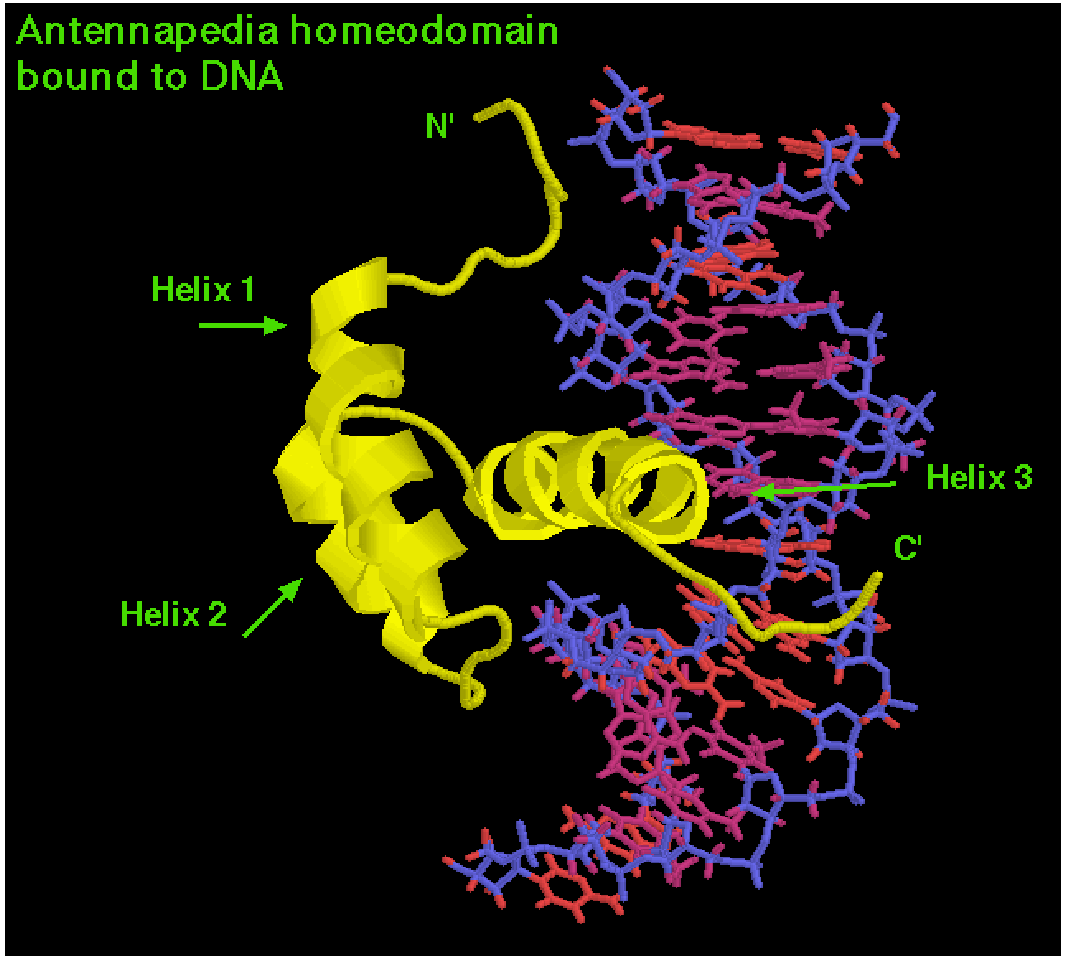
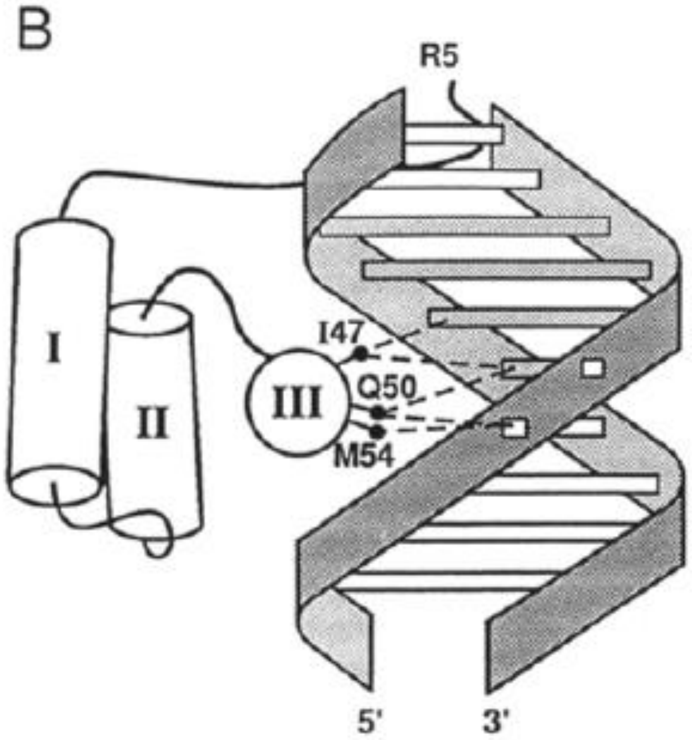


Fig 6. Chromatin marks and Hox expression in tailbuds from 8.5 day and 9.5 day mouse embryos. *Over this period of development more posterior tissues arise within the tailbud and, correspondingly, more posterior Hox genes (*Hoxd8 *to d13) become expressed. There is accompanying loss of H3K27me3 and gain of H3K4me3 marks. H3K27me3 marks, in particular, suggest evidence of a single boundary between active and inactive Hox genes, and the position of this boundary in the cluster has shifted in the more posterior (older) tailbud. Embryo stem cells (ESC) are used to represent an earlier Hox-inactive stage. They show ubiquitous presence of both H3K27me3 and H3K4me3 marks, characteristic of bivalent chromatin, but at levels less than those reached after Hox gene expression. ESC, embryo stem cells. From Soshnikova and Duboule, 2009. Reprinted with permission from AAAS.*

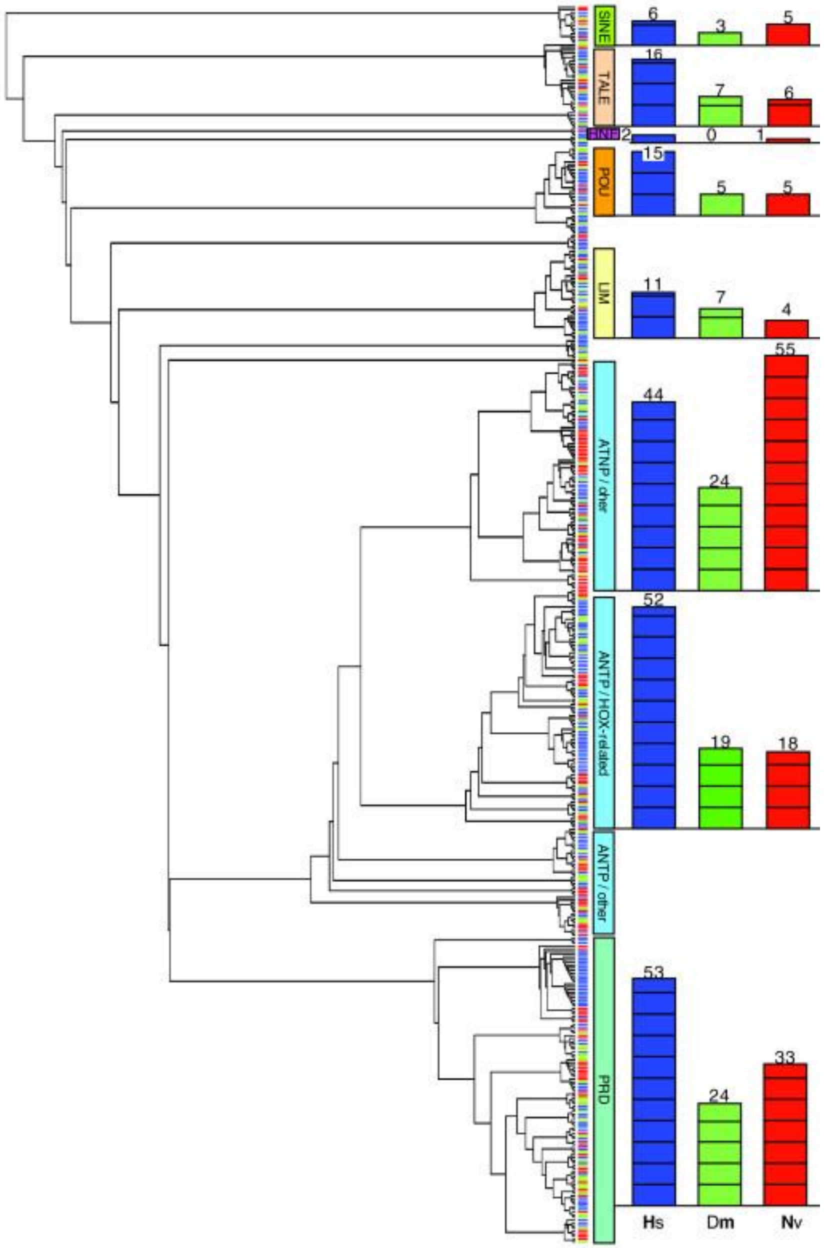
Gaunt 2015

El homeodominio





Expansión de proteínas con homeodominio en Animales



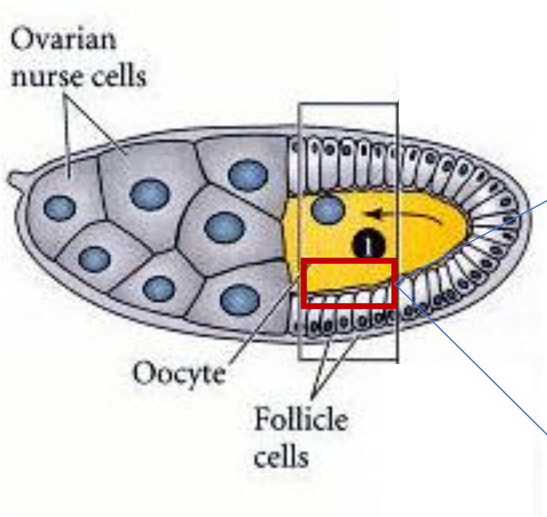
(Hox son sólo un grupo entre las proteínas con homeodominio)

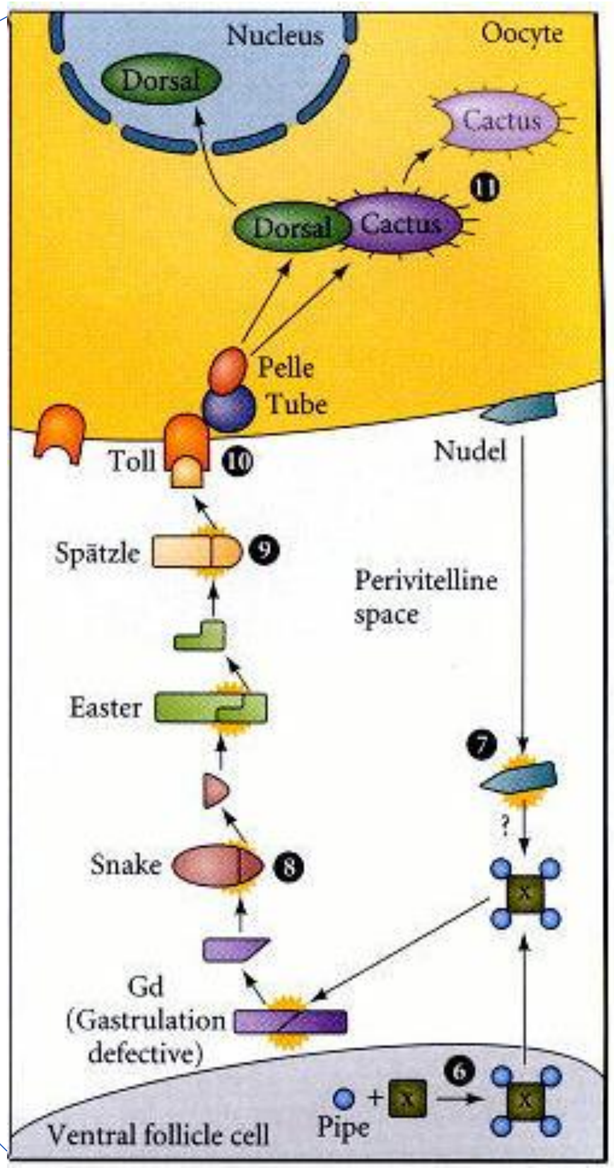
Homo sapiens
Drosophila
***Nematostella* (Cnidaria)**

Ryan et al 2006

Eje Dorso-Ventral

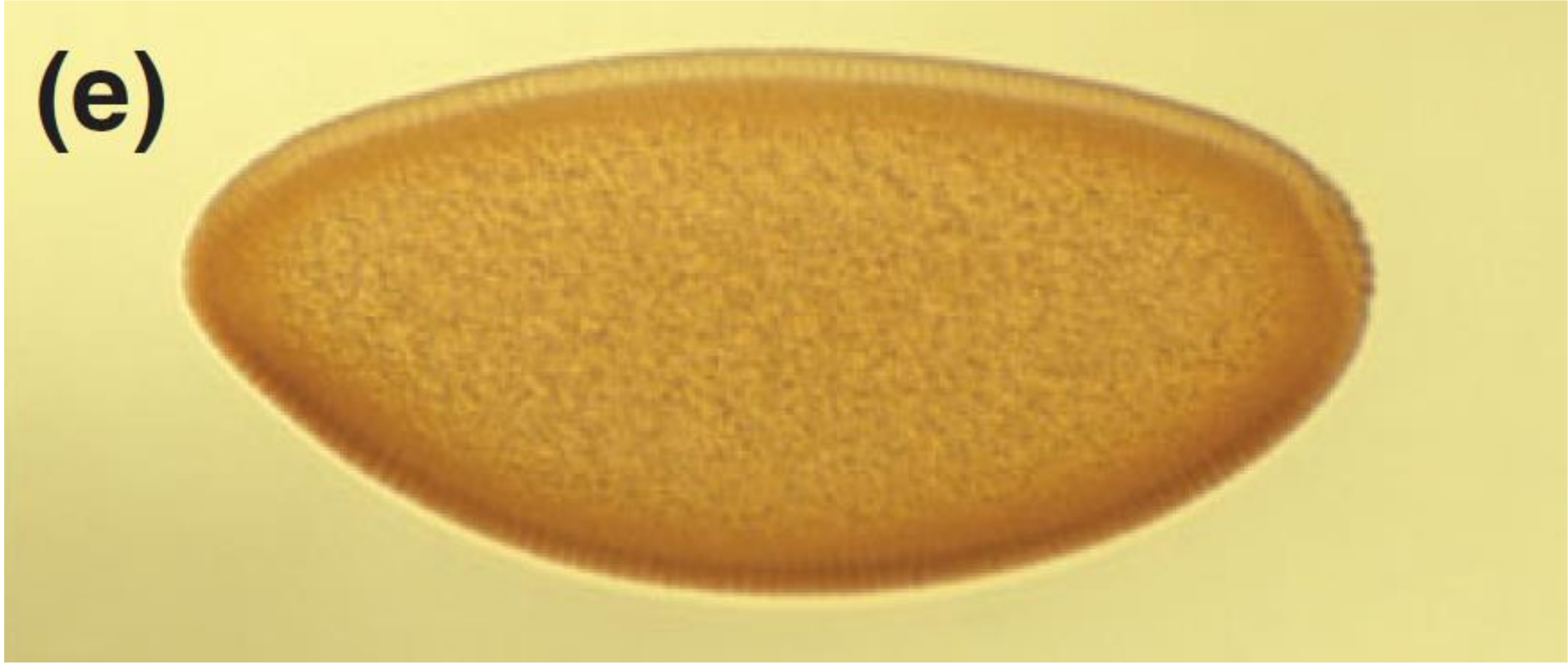
Establecimiento del eje dorso-ventral en *Drosophila*

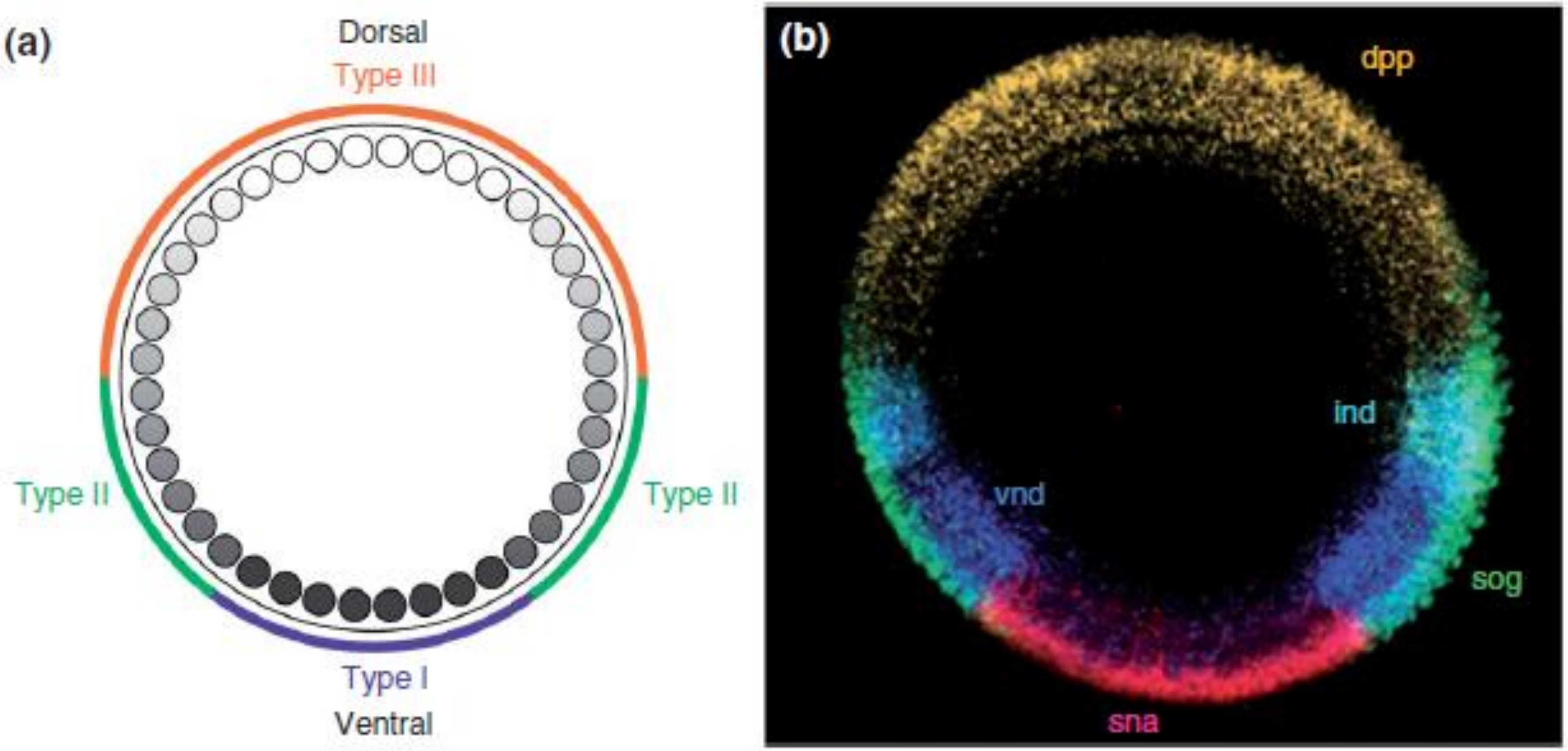


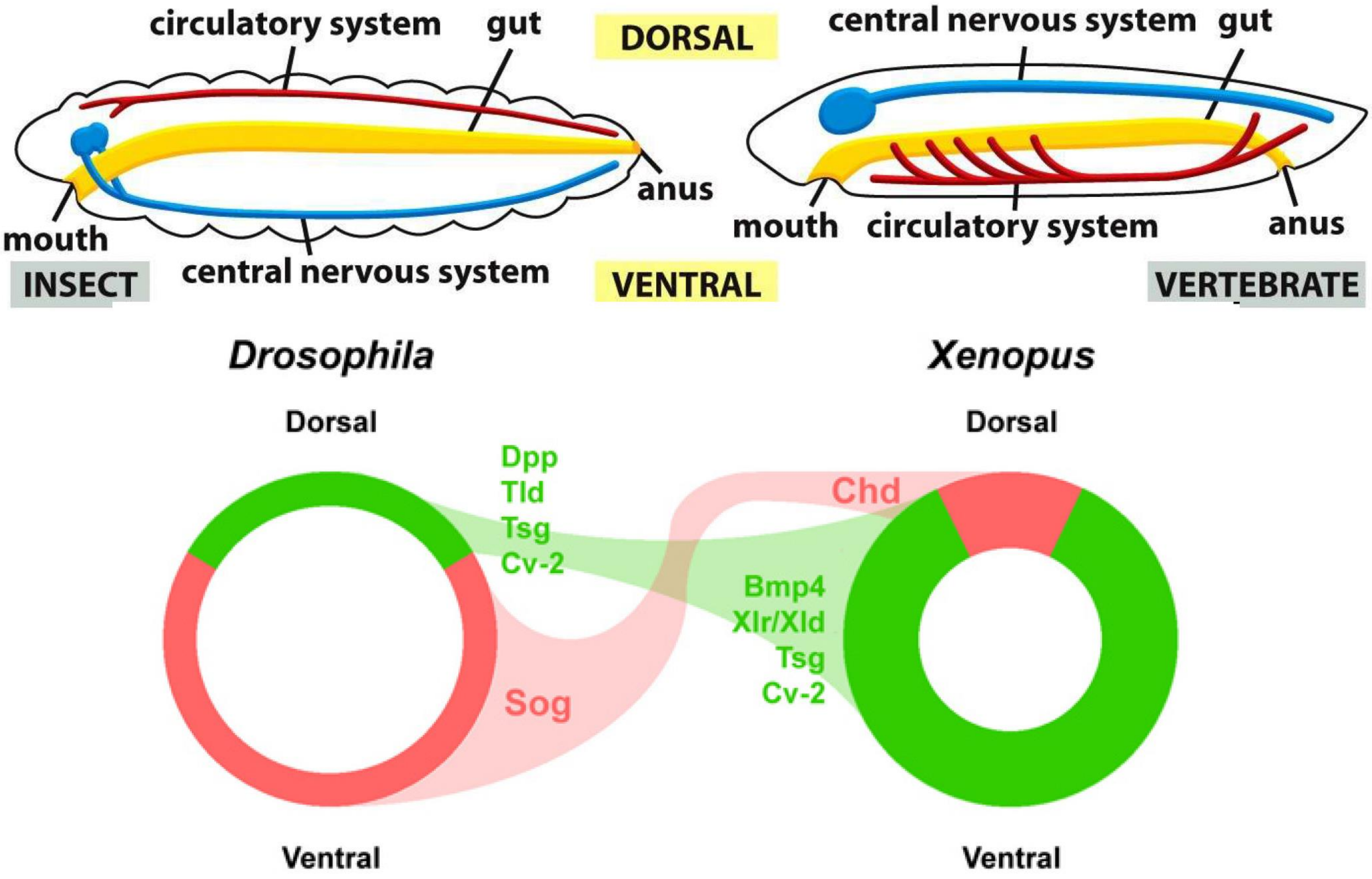


Cascada de proteólisis extracelular iniciada por células foliculares ventrales activa al ligando Spätzle

Activación del receptor Toll y del factor de transcripción Dorsal


(e)


(a)
Dorsal
Type III
Type II
Type II
Type I
Ventral
(b)
dpp
ind
vnd
sog
sna


circulatory system
gut
DORSAL
central nervous system
gut
anus
mouth
INSECT
central nervous system
VENTRAL
mouth
circulatory system
anus
VERTEBRATE
Drosophila
Xenopus
Dorsal
Dorsal
Dpp
Tld
Tsg
Cv-2
Chd
Bmp4
Xlr/Xld
Tsg
Cv-2
Sog
Ventral
Ventral

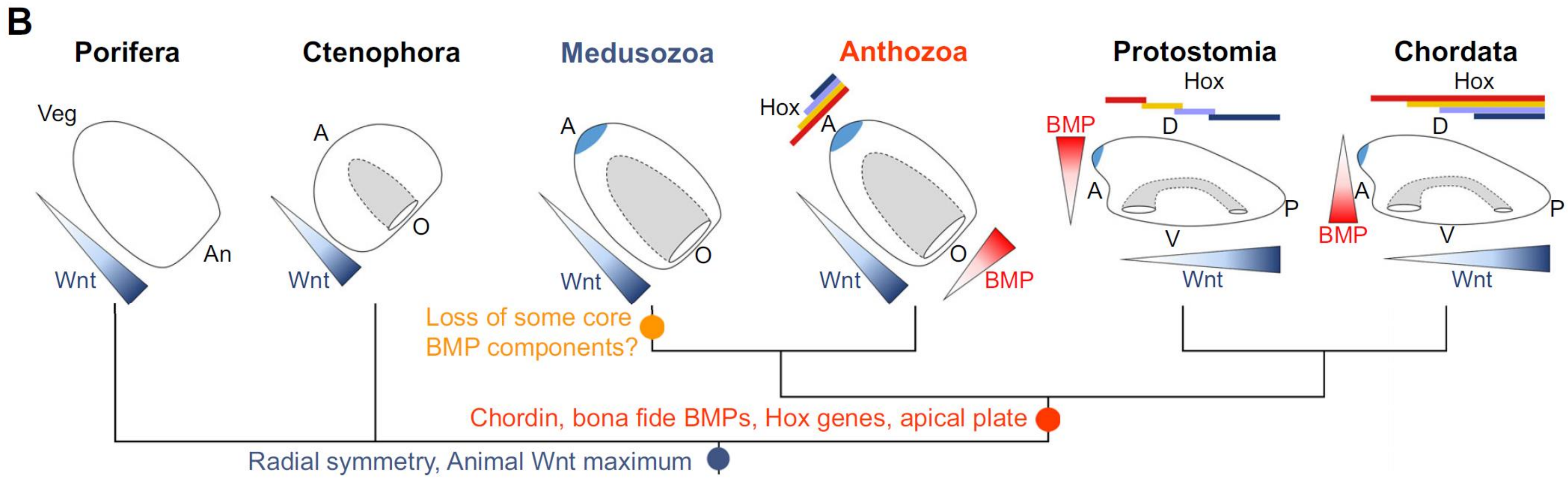
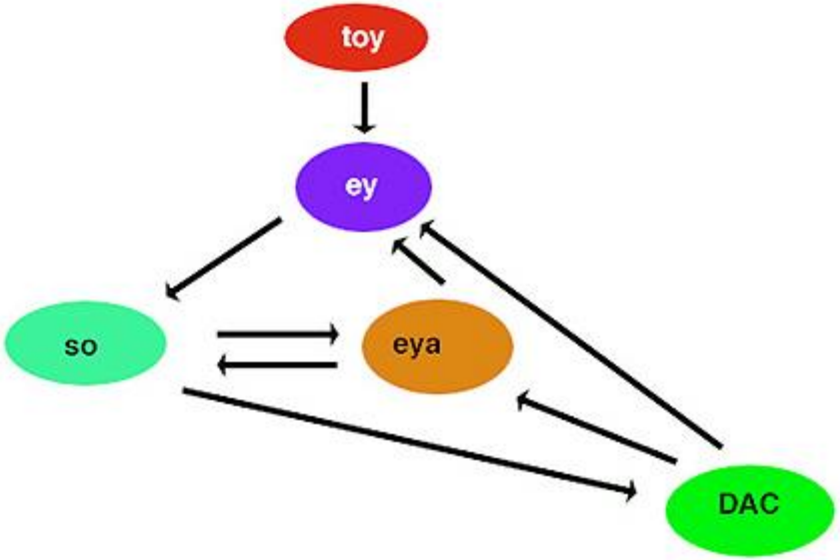


Fig. 5. The distribution of selected molecular traits amongst animals. (A) Table summarizing the presence or absence of several key regulatory components in the genomes and transcriptomes of Porifera, Ctenophora, Cnidaria and Bilateria. (B) The direction of the Wnt and BMP signalling gradients, and the expression of Hox genes, throughout Metazoa.

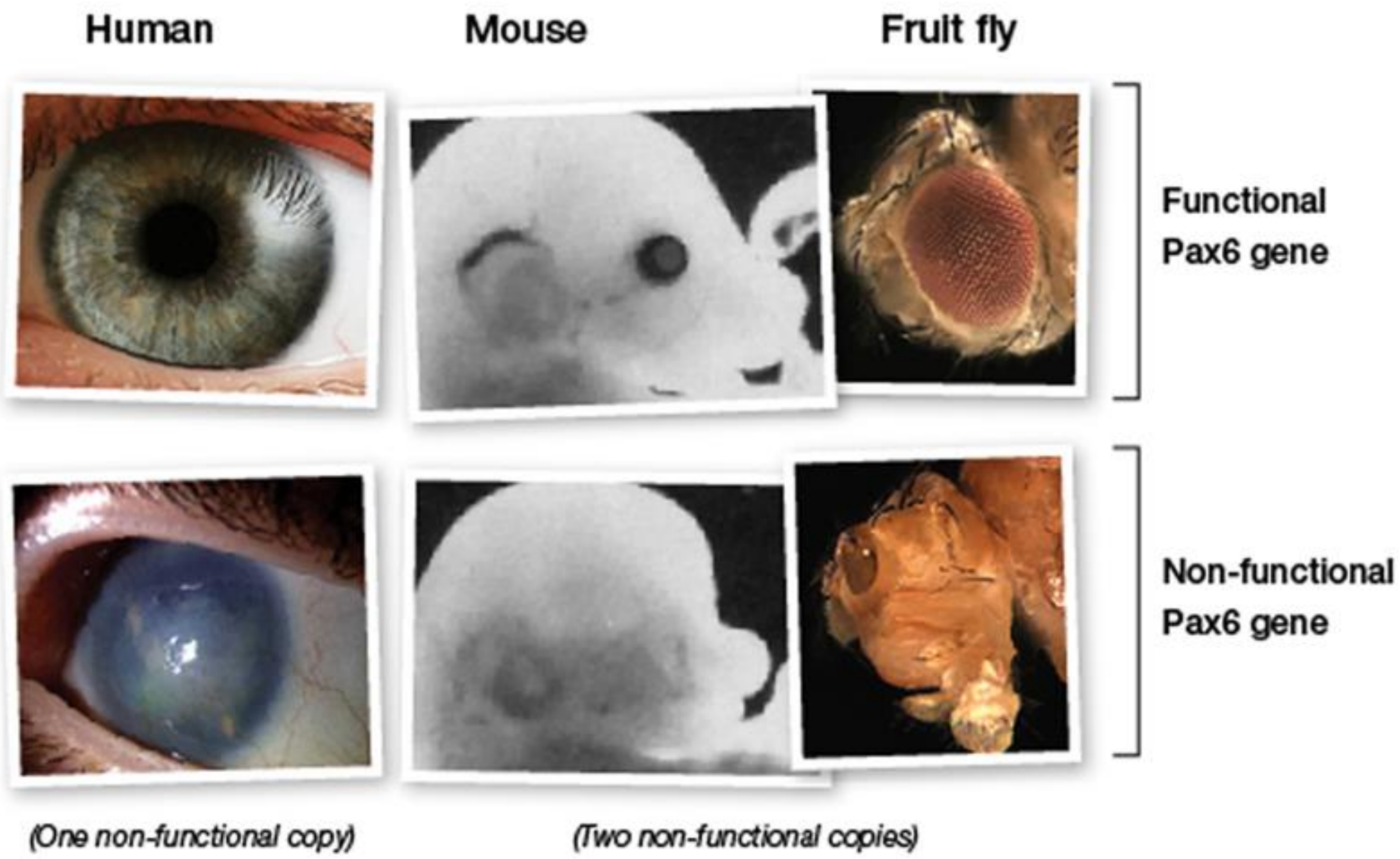
Genikhovich*

“Genes maestros”- Pax6 y el desarrollo del ojo

http://www.ralf-dahm.com/



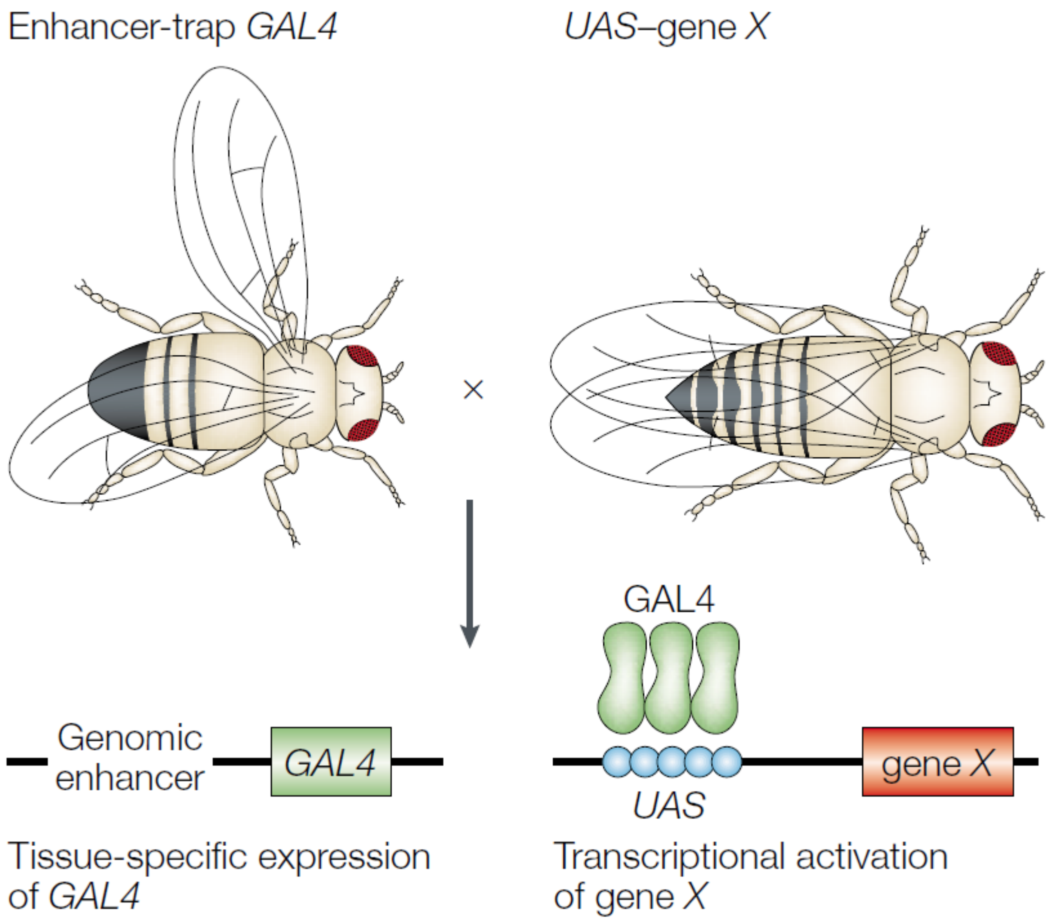
“Genes maestros”- Pax6 y el desarrollo del ojo



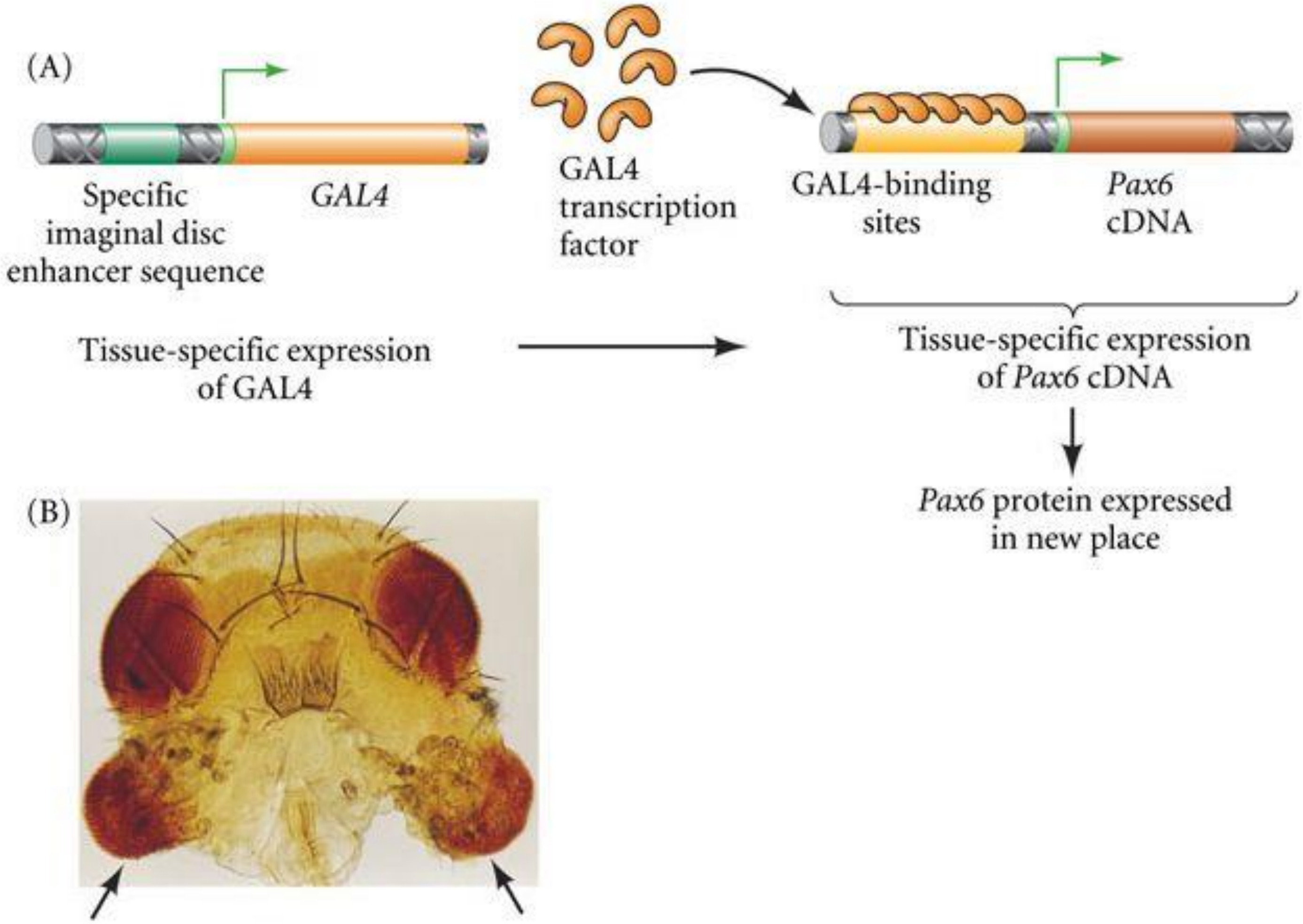
http://www.discoveryandinnovation.com/BIOL202/notes/lecture21.html

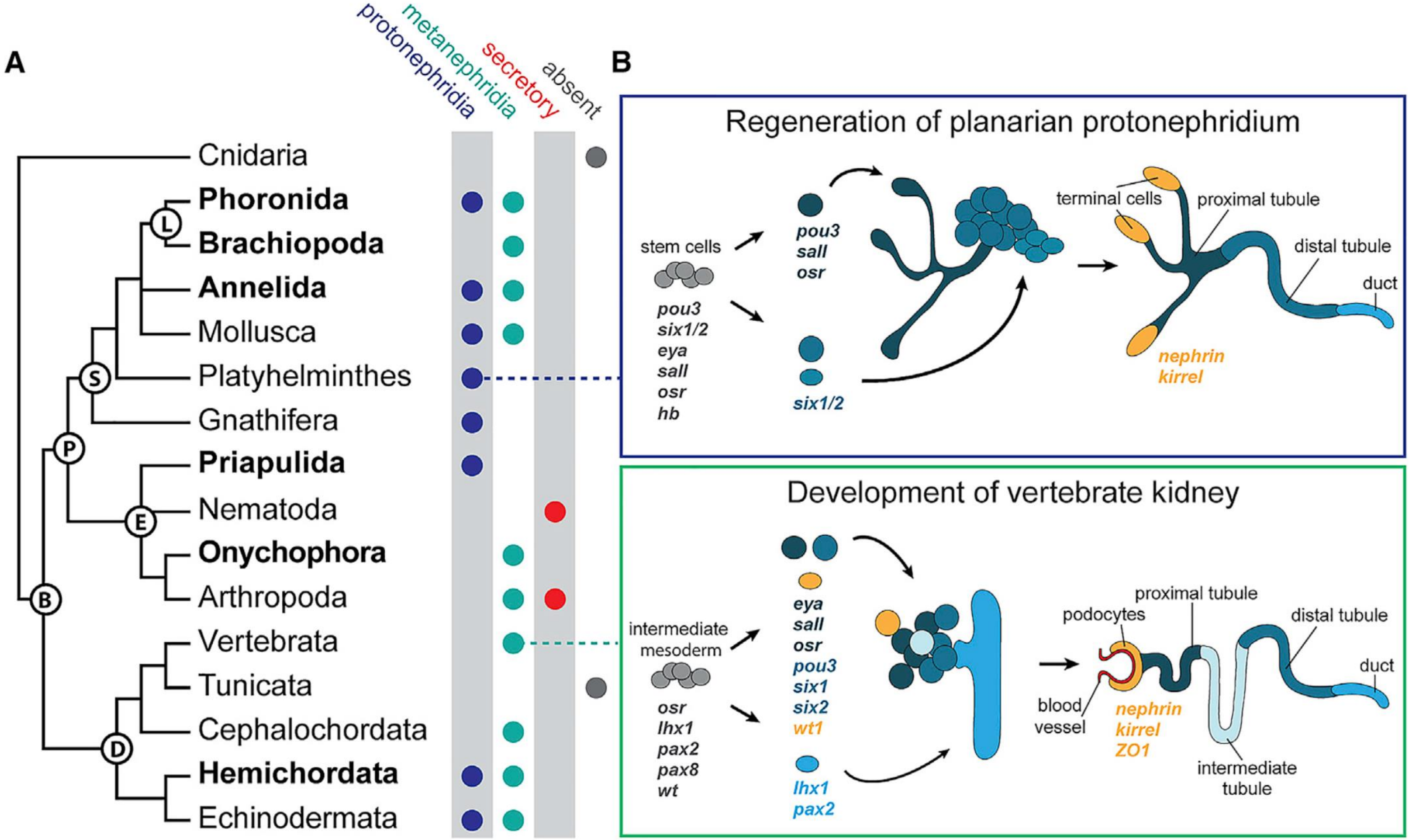
Box 2 | The *GAL4–UAS* system for directed gene expression

The yeast transcriptional activator Gal4 can be used to regulate gene expression in *Drosophila* by inserting the upstream activating sequence (*UAS*) to which it binds next to a gene of interest (gene *X*)[96]. The *GAL4* gene has been inserted at random positions in the *Drosophila* genome to generate 'enhancer-trap' lines that express *GAL4* under the control of nearby genomic enhancers, and there is now a large collection of lines that express *GAL4* in a huge variety of cell-type and tissue-specific patterns[97]. Therefore, the expression of gene *X* can be driven in any of these patterns by crossing the appropriate *GAL4* enhancer-trap line to flies that carry the *UAS*–gene *X* transgene. This system has been adapted to carry out genetic screens for genes that give phenotypes when misexpressed in a particular tissue (modular misexpression screens)[79].



“Genes maestros”- Pax6 y el desarrollo del ojo





Gasiorowski *et al* 2021

El “zootipo” y el antepasado común de los animales bilaterales (“urbilateria”)

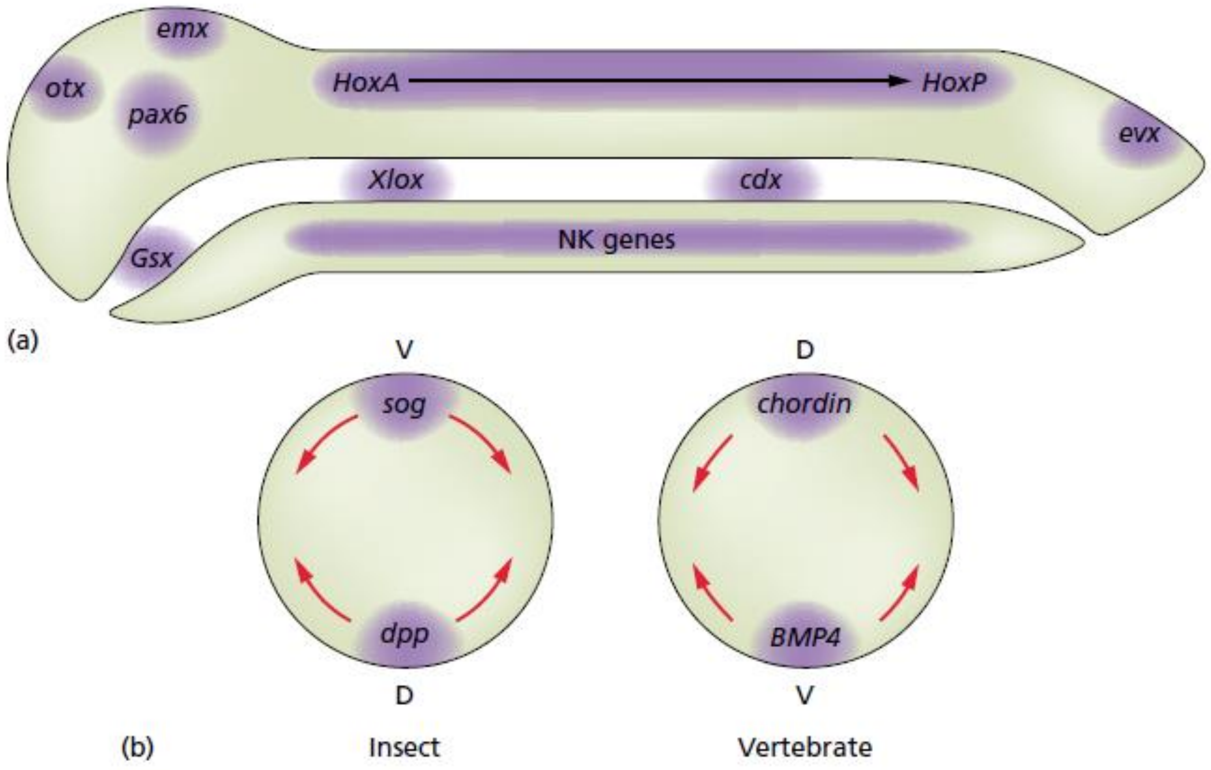
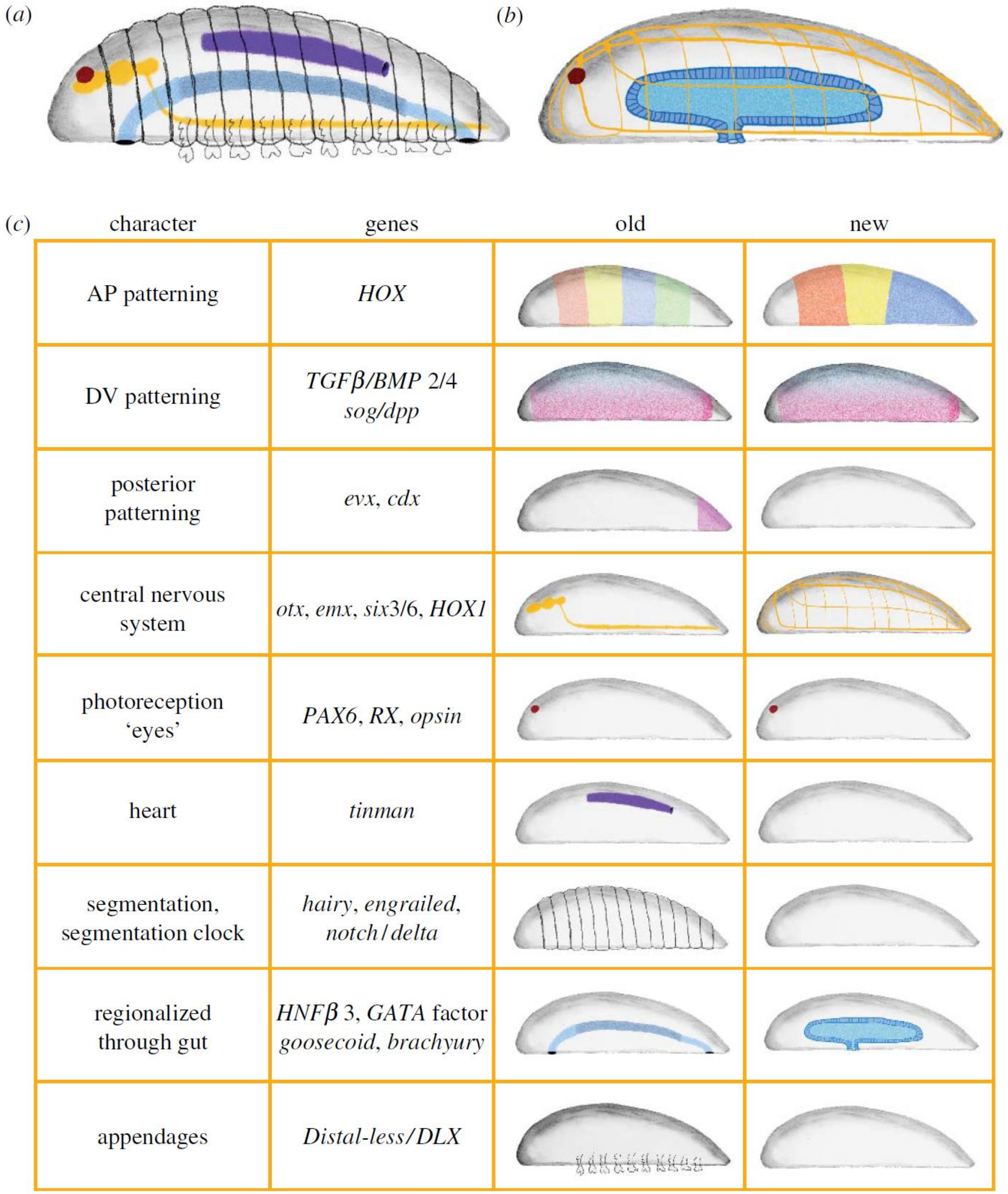


Fig. 20.6 The “zootype,” or common constellation of expression domains for developmental genes found in the animal body plan. (a) Transcription factors active at the phylotypic stage. (b) Homologous dorsoventral signaling systems in insects and vertebrates.

Slack 2006 Essential Developmental Biology



Hejnol & Martindale 2008

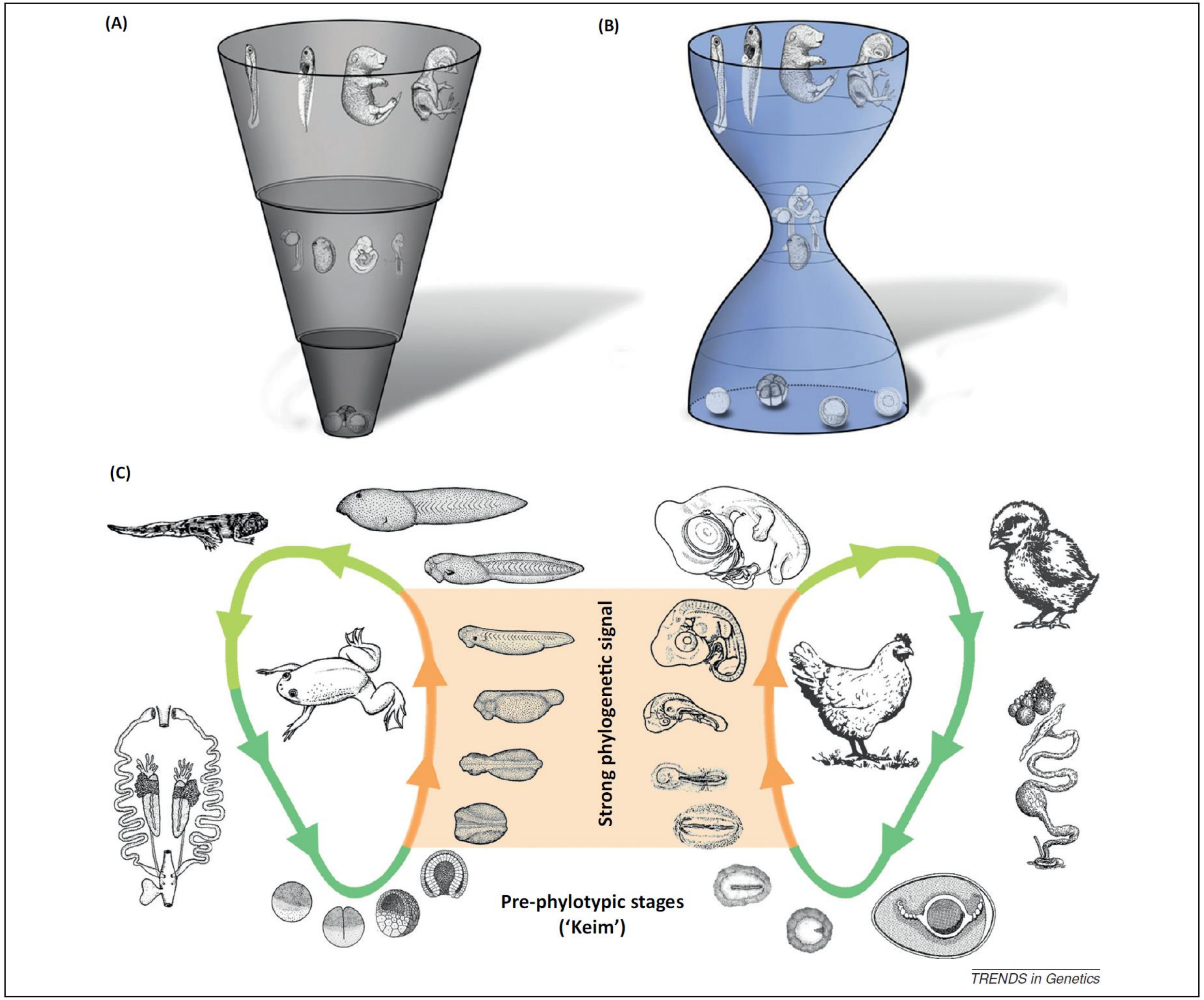


Figure 6. Different views of developmental evolution: the 'funnel' model (**A**), which suggests early conservation and the 'hourglass' model (**B**), which limits conservation only to the phylotypic stage [76,88]. Karl von Baer's original observations suggested a high degree of parallelism in biological complexity and developmental changes for the mid- to late-stage embryos (**C**). Orange indicates embryonic development from the pharyngula stage to hatching, light green indicates postnatal development, and dark green indicates the adult stage.

Abzhanov 2013